Distr.
LIMITED

UNIDO/IS.423
21 December 1983

ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

THE RESOURCE BASE FOR INDUSTRIALIZATION IN THE GULF CO-OPERATION COUNCIL COUNTRIES: A FRAMEWORK FOR CO-OPERATION *

Prepared by the

Regional and Country Studies Branch
Division for Industrial Studies

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EXECUTIVE SUMMARY

THE RESOURCE BASE FOR INDUSTRIALIZATION IN THE GCC COUNTRIES: A FRAMEWORK FOR COOPERATION

The major purpose of the study is to provide the first stock taking of the natural resource base of the GCC region as a whole. A secondary purpose is to make some suggestions as to the appropriate broad focus and emphasis of future policies designed to foster resource-based industrialization.

The report is organized into four parts. Part I provides background material, giving the context of the study. Part II constitutes the heart of the report, and provides a survey of the natural resource base of the region. Some possible uses of the resource base are discussed in Part III. Part IV concludes with a summary of the study and of the main policy-relevant suggestions.

The introduction and overview chapters of Part I discuss, among other things, the rationale for resource-based industrialization, and provide a brief summary of the natural and human resources of the region. Considerable attention is paid to the presentation and interpretation of aggregate income and expenditure accounts for the member countries and for the GCC region as a whole. In addition there is a detailed analysis of the pattern of commodity trade flows, both within the GCC region and with other regions of the world, and a discussion of the accumulation of foreign assets and of migration.

Part III consists of seven chapters, concerned with the natural resource base in the region, and with its utilization. There are chapters on: water resources, agriculture, fisheries, oil and gas, metallic minerals, non-metallic minerals, and waste materials as a source of recoverable resources. Collectively, these chapters are intended to provide an exhaustive inventory of the currently known resource base of the region as a whole, and of the GCC member countries separately. While every attempt has been made to ensure that the inventory is as complete as possible, some important items will undoubtedly have been missed. Such omissions can, of course, be corrected. The very nature of the known resource base is that it changes over time as new information becomes available, and updating the inventory for the region is itself a worthwhile activity. In any event, it is felt that Part II provides a reasonably accurate picture of the overall resource base of the region, to the extent that it is currently known.

Good quality water is undoubtedly a valuable resource in the region, and one that is in scarce supply. It is a particularly important resource, since industrial and agricultural activity depend so heavily on it. Furthermore, it is a shared resource since much of the water supply is not easily renewable, but instead is fossil water contained in aquifers, many of which are shared by two or more countries in the region. In addition, much water is produced by desalination. Detailed water balances prepared for each country for 1980, with projections for 1985, suggest that while water supplies generally exceed demand in both years, there are problems in particular areas, such as Bahrain. The projected expansion of the water supply in all countries is mainly through the use of desalination plants. Clearly desalination plants are expensive to construct and to operate, which suggests an important role for effective water management policies, and this topic is discussed.

Even with the extreme scarcity in the GCC region of land which is suitable for crops or for pasture, both crop and livestock production have increased markedly in recent years, and there is considerable potential for the further expansion of agricultural output. However, the high opportunity cost of water in most of the region suggests that it should be used sparingly. Also, the introduction of advanced technology in agricultural production requires the use of skilled labour, without which the existing resource base could easily be destroyed. Even with these provisos, there is considerable potential for expansion from existing levels of output. At the same time the output potential is not sufficiently great to provide much of a food security buffer.

The fishery resources of the GCC region also have considerable productive potential. The waters surrounding the region are rich in many varieties of fish, and a very conservative estimate suggests that the overall catch could be increased at least four times before potential yields are fully realized.

Oil and gas are obviously the dominant natural resources of the region at this time. As is well known, the region is the world's largest oil producer, and has its largest pool of proven resources. It is less well known that the region also has very large reserves of gas. The use of this dominant component of the natural resource base is, of course, a central issue in the region's development strategy.

The available evidence suggests that the region has substantial deposits of various metallic minerals -- including copper, zinc, lead, iron, chromium, zirconium, thorium, uranium, aluminum, gold, and silver -- and that the deposits are concentrated mainly in Saudi Arabia and Oman. While the known deposits are relatively small when considered on a global scale, they are very important on a more local scale. Furthermore, there is now substantial capacity within the region to produce iron, steel, aluminum, and copper, and some expansion is planned. These industries form a critical link in the on-going process of industrialization, since they provide both relevant materials and valuable experience in the use and management of advanced industrial processes.

The non-metallic mineral resource of the GCC region are more widely distributed among the member countries. There are large reserves of gypsum, limestone, and clay which supply the cement industry, and of sand and gravel which supply the construction industry. Other reserves -- including quartz sand, ornamental stone, phosphate, sulfur and high salinity sea water -- could also be further exploited.

Part III is concerned with an overview of possibilities for putting the resource base of the GCC region to effective use over the next few years. The approach adopted is to consider an exhaustive classification of commodities, and to provide a necessarily preliminary assessment of the ones whose production might suitably be encouraged in the region, given its resource base. Those commodities whose production requires relatively large inputs of energy and capital, and relatively little water and labour, are candidates for further consideration. Those commodities whose production would utilize the natural resources of the region and also encourage the further development of local human skills are, of course, especially interesting candidates. The importance of the market tests is emphasized throughout: it is important that the industries which are established by making use of the current oil wealth should not continue to require subsidies, but should instead soon become self supporting and fully competitive, and themselves contribute to the process of further industrializing the region.

A number of suggestions having relevance for the possible use of resources to promote resource-based industrialization are presented throughout the report, and summarized in the concluding chapter. Elaboration of the following points is provided there, and at various places throughout the text. Among other things, it is suggested --

1. That the GCC consider ways to assist in the coordination of the collection of data and the dissemination of statistical information.
2. That the GCC work with the member countries to establish priorities with respect to the development of a unified data base for the region.
3. That the GCC consider the establishment of a regional manpower council which could work closely with national development planners.
4. That the GCC Water Committee concern itself especially with the utilization and development of water resources at the regional level.
5. That the efficient expansion of the agricultural sector requires the development of skilled manpower, sophisticated irrigation practices, integration of various activities within agricultural ministries, and the coordination of activities within the region.
6. That a specialized agency might be empowered to manage the rich shared fish resources in the Gulf, the Arabian Sea, and the Gulf of Oman.
7. That the integration of refining, processing, shipping, and marketing activities in connection with the oil and gas reserves is an obvious and very promising way to encourage industrialization; that production should be on a narrow range of mature products, initially; that production facilities be large; and that investment plans of the member countries be coordinated.
8. That the GCC region is not rich in known mineral deposits, but a number of deposits have been identified which warrant commercial exploitation (including iron ore, bauxite, copper, and gold).

9. That nonmetallic minerals are widely distributed throughout the GCC region; that some reserves are quite large and could possibly be exploited further (including gypsum, limestone, clay, sand, gravel, quartz sand, ornamental stone, calcareous phosphate).

10. That scrap metal and paper products are waste materials from which useable resources might be recovered on a cost-effective basis.

11. That on the basis of a detailed scheme in which commodites were classified according to capital intensity, the complexity of further processing, and market size, and the resource base of the region was taken into account, a long list of commodities was identified as potentially viable for production and/or expansion in the region.

12. That the GCC region might usefully be viewed as a primary ring of production, and its economic interactions over wider rings could be considered to find ways to exploit mutually advantageous trade and investment opportunities.

13. That a GCC Payments Union might be considered as a means to strengthen the institutional mechanisms accommodating regional economic interactions.

14. That a GCC analogue of SABIC might be established to assess, coordinate, and promote the establishment of various engineering products industries within the GCC region.

15. That the approach to growth and industrialization might centre around carefully selected growth poles, with an emphasis on the capital goods sector while giving attention to the need for balance.

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Foreword

Through its programme of regional and country studies, UNIDO's Division for Industrial Studies carries out analyses of industrialization prospects in individual and groups of developing countries. By a systematic stocktaking and assessment of the endogenous resources, current production structures and development constraints pertaining to industry in a particular developing country, UNIDO aims at assisting the national policymaker in obtaining an analytical basis for conceiving long-term industrialization strategies and policies.

In this programme of studies, attention is given also to assessing the prospects for regional industrial co-operation between the two or more developing countries. The systematic examination of the joint resource base and of possible industrial complementarities in a regional grouping is indeed an essential starting point for designing concrete industrial co-operation schemes which may generate significant gains for the countries involved.

This particular study on the member countries of the Gulf Cooperation Council was carried out through a joint GCC/UNIDO programme under a trust fund agreement. UNIDO believes that this study constitutes a fairly comprehensive review of resources in the GCC countries as a whole and hopes that the study can serve the GCC as a solid data base for conceiving specific joint industrial development. It is also expected that the study can be used as a general guideline for surveys of other regional groupings.

The study was carried out by a team of experts in co-operation with UNIDO staff. The team consisted of the following members:

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UNIDO wishes to gratefully acknowledge the very active role played by the GCC throughout the various phases of the project and wishes to thank the authorities of each of the member countries for their guidance and for the support given to the team in data collection.

PART I

INTRODUCTION AND OVERVIEW

CHAPTER 1

INTRODUCTION

1-1. BACKGROUND

Contrary to popular belief, economic prosperity in the Arabian Gulf region is not a new phenomenon. Gulf traders in their dhows long ago traveled far afield, down the east coast of Africa, to the Indian subcontinent, to the East Indies and to China. Gulf dhows sailed these routes constantly and have been credited with hauling the major share of trade between India, Africa and the Gulf over a period of many centuries. Pearling and fishing thrived in the narrow straits of the Gulf, thus adding to the gains from shipping and the caravan business which fueled a prosperity that lasted until the 19th century when the region began to have substantial contact with western colonialism.

The contact with western colonialism led to the destruction of traditional activities and a diminished importance of the traditional shipping routes, and by the time the world depression of the 1930's arrived, the Gulf was at the nadir of its economic fortunes. Then, with the discovery of oil, and its subsequent exploitation, the situation changed dramatically. Oil was discovered as early as 1932 in Bahrain, but the major shift in fortunes came with the Iranian oil crisis of 1951.[1] Even so, prior to 1973, oil revenues of most of the governments of the region were not sufficient to finance large-scale developmental efforts, and it was not until the major increase in oil prices during the period October 1973 - January 1974 and the subsequent increase in the domestic ownership of the oil industry that significant amounts of financial capital became available and provided the potential for very rapid economic development.

In spite of the massive volume of savings that ensued, and the huge accumulations of foreign exchange, the desired pattern of rapid and sustained economic growth did not follow immediately for the GCC countries. The savings and exports of the region exceeded by far its investment and import requirements, but a new set of constraints came into effect -- a set generally referred to as limitations of "absorptive capacity." Skill shortages, problems of scale limitation, scarcities of physical resources, inadequate infrastructure, and limited administrative and institutional machinery for monitoring and controlling the economy suddenly came into prominence, and the pace of growth, while rapid by any standard, fell far short of the potential that the new levels of oil revenues had seemed to offer. Any one of the constraining influences would have been sufficient to thwart the domestic growth process, let alone the full set of them. A careful setting of priorities and an orderly attack on the problem of limited absorptive capacity came to be recognized as the essential elements of national policy in the 1970's.

1-2. DEVELOPMENT THROUGH COOPERATION

Culturally, historically, geographically, and politically the GCC states represent a rare instance of regional homogeneity, and the problems that confront them are similar also. Collectively and individually, they face the striking realization that, unless priorities and plans are set with care, the gestation period of economic development may be longer than the expected life of their hydrocarbon resources. They face the challenge of accumulating enough productive capital (human and physical) in the non-oil sectors of their economies, and of raising productivity sufficiently in those sectors, to offset the drawing down of oil reserves. In a sense, they are in a race against time. Standards of living in the region have risen markedly, of course. Extensive welfare programs have been introduced which are a source of admiration by the most ardent socialists, and there have been massive improvements of infrastructure, of the educational system, and even of heavy industry. However, this has been accomplished at the cost of substantial capital consumption, in the sense that oil reserves have been depleted at much faster rates than human and physical capital have been created to replace them.

The realization that the region has not yet nearly reached the threshold of sustained economic growth independent of oil revenues is coupled with the realization that the necessary rate of sustained growth may be possible only within a framework of regional cooperation and economic integration. The general perception of vulnerability associated with the vast wealth of the region, its limited military capabilities, its relatively small and dispersed population, the extensive land mass of the Arabian Peninsula, and the belligerence of some of the neighbouring states has added urgency to the quest for cooperation.

1-3. THE GULF COOPERATION COUNCIL (GCC)

The vast financial wealth of the region, its political and cultural homogeneity, the small sizes of individual markets, economic duplication and lack of coordination, the potential rewards from collective bargaining power, and increased external threats provided a combination of circumstances that culminated, in February 4, 1981, in the formation of the Gulf Cooperation Council. The Council members include Saudi Arabia, Kuwait, the United

Arab Emirates, Qatar, Bahrain and Oman.

Although the GCC is not exclusively an economic association, it is perhaps the most promising effort in economic cooperation among developing countries in recent history.[2] In fact, the GCC has been successful in establishing a number of agreements in the fields of defence, foreign affairs, education and energy.[3] However, the Economic Agreement (EA) of June 8, 1981, is perhaps the GCC's most important achievement. The EA is embodied in a comprehensive document which details the framework, mechanisms and principles of coordination, harmonization and integration of economic activity in the region.

The EA consists of seven parts and 28 articles. The major elements of the agreement are the following:

(1) a free trade area in the region with no tariffs on regional products and a common tariff on non-regional outputs;

(2) a pooling of bargaining power when dealing with trading partners outside the region;

(3) a common market area in which citizens of the Council member countries are free to move, work, own, inherit and bequest within each and every country of the Council;

(4) a call for harmonization of development plans with the aim of complete integration;

(5) a common oil policy and a coordinated policy of industrialization based on oil resources;

(6) a coordinated industrial development policy for the region as a whole;

(7) special emphasis on establishing and promoting joint projects in all

sectors with the aim of tying the production chains of the region into a common development sequence;

(8) cooperation in the development of local technology and the joint acquisition of foreign technology;

(9) pooling of human resources to prevent harmful competition for scarce labour;

(10) linking the regional markets through roads, rails, air and water transportation networks;

(11) a common legal framework for trade and investment in the region;

(12) a common development aid policy.

There is a wide range of possible instruments or patterns for economic cooperation among countries, extending all the way from customs unions to full integration. The GCC's Economic Agreement seems to have spanned much of this range. Another distinctive feature is the adoption of the principle of gradualism, so that cooperation is expected to proceed pragmatically and cumulatively, rather than abruptly. Furthermore, and perhaps uniquely, the EA stipulates an important role for the private sector in the implementation and maintenance of economic inter-relationships.

The framework of cooperation is a dynamic one. The emphasis on the coordination of investments, of development effort and of complementary activities takes its context from a desire to foster growth and development by reaping the benefits of rationalization of production and intra-regional specialization. In this regard, the EA is balanced, realistic and forward looking.

It is clear also that the EA recognizes the formidable barriers to market integration imposed by the physical environment of the region.

Thus markets and production activities are to be integrated by a deliberate linking of road, railway and air transport networks. The economic "balkanization" of the area can be eliminated only as national infrastructures come to be joined and integrated within a common regional framework, and this has come to be recognized.

The common characteristic of an overwhelming and continuing dependence on oil may be related, in some measure, to the small size of the individual economies of the GCC member states. This limited size may have inhibited economic diversification of the national economies in the past. Collectively, though, the countries of the GCC may be able to develop and sustain a much more diversified economic base. Not only is the market greater, but so are the pools of natural resources and the bargaining power of the countries when they act in concert.

The Council has been concerned to take stock of the region's natural resources and of its sources of supply of other products as an essential step in the planning of a diversified, resource-based program of industrial development. The purpose of this study is to survey, quite broadly, the resources of the GCC region, and to determine the region's potential for industrial development, based on the utilization of raw materials and semi-finished products which are now produced within the region, or which could be produced if the necessary investments were undertaken.

1-4. THE RATIONALE FOR RESOURCE-BASED INDUSTRIALIZATION

The strategy of basing industrial development on advanced stages of processing of natural resources is generally motivated by the desire to capture the high value-added component of such activities, to diversify production and exports, and to exploit such comparative advantages as may exist in the production of competitive commodities. Industrial processing may also contribute to several other development goals. Processing often entails high degrees of utilization of capital and energy, and this fits well with the resource endowments of the GCC region and with the desire to avoid increasing dependence on an already scarce supply of labour, especially skilled domestic labour. The diversification of exports is important because the markets in which finished products can be sold are more diversified geographically than those of crude oil and minerals. Hence, processing before export (or before re-export) might allow the GCC to capture some of the monopsony profits formerly absorbed by the heavily concentrated buyers of crude minerals and other raw materials. When the processing of raw materials is carried to the fabricating or manufacturing stages, it may also encourage local production of products not related to the original raw materials. In this way, forward and backward integration of the input-output structure of the economy might lessen the GCC's dependence on crude oil, and thus promote more generally the important objective of industrial diversification.

Access to expertise and technology is required for the design and implementation of investment programs and for the operation of new plant and equipment. Furthermore, a market for the output must be assured. The collaboration of transnational corporation (TNC's) may be necessary, as these often hold strong monopoly control over technology and markets. But TNC's are not easily pursuaded to relinquish their monopoly power, and they may be unwilling to share their knowledge with the developing countries.

Moreover, the governments of industrial countries are anxious to protect the interests of their labour and capital employed in processing within their own territories, and in this their aims coincide with those of the TNC's. Such protection is commonly assured by imposing tariffs that rise with the degree of processing. In many cases, the effective tariff on value added in processing is so high as to make profitable processing in developing countries very difficult.

When foreign support has to be called in, and where the level of national skills in relevant fields is low, it may be necessary to conclude a comprehensive management contract with a TNC to ensure efficient operation. In other cases, resources available within the region may be sufficient for regular staffing of the venture, but foreign support may nevertheless be needed for special tasks such as supervising technical installations or seeking out the best sales opportunities in the international market. Sometimes, when foreign services are needed on a comprehensive basis, and the suppliers are in a strong position to dictate their own terms, a way out is to pay the foreigners by assigning to them part ownership of the venture. The major conclusion here is that independence in industrial processing presupposes the development of national competence, in the form of skilled and knowledgeable individuals and appropriate institutions. The advantages of industrial development to a nation tend to be much reduced in the absence of such competence.

The present world allocation of processing activities is, to some extent, the outcome of the biased structure of transport costs. The savings in transport costs from reduced volume and weight of processed products is often not fully reflected in reduced transport charges imposed by shippers (especially conference shippers). The development of their own shipping fleets may assist the development of processing activities in developing countries, and the GCC is in an advantageous position in this respect.

The successful involvement of GCC countries in the processing of raw materials and semi-finished goods will depend on a number of interrelated factors. Three such factors will be decisive: input availability; conditions of processing; and characteristics of output.

Input availability must be measured by comparative cost criteria. Raw materials and other complementary inputs are assessed in terms of their availability in sufficiently large quantities to make it possible to process them economically in situ. Whether they can be imported at advantageous prices, as an alternative to domestic supply, is another critical consideration.

The conditions of processing are determined by the technologies used in the processing activities, and here there are three main considerations. The first pertains to the extent to which economies of scale facilitate or impede the locating of productive capacity in the region, because of the abundance or lack of abundance either of the raw material itself or of other complementary inputs. The second relates to the range of technological choice available within the industry, and possibly to the availability of processing systems that are particularly suited to the conditions of the region. The third has to do with the development of new technologies, or variants of existing ones, that may alter some of the circumstances militating against processing in the region

The characteristics of output that are of special importance are those that determine the difficulties encountered in supplying end-products to their markets, including transport and storage problems, tariff and non-tariff barriers, and other difficulties associated with marketing and distribution.

A recent study has indicated that non-ferrous metals, industrial chemicals, and petroleum refining are particularly low in labour intensity, when compared with other major production sectors.[4] A study of investment potential in developing countries showed all resource-based industries except wood products to have capital-labour ratios of 3 to 10 times the average for all industries combined, and labour coefficients 33 to 80 percent below the average.[5] Evidence such as this, although admittedly not conclusive, tends to suggest that this type of industrialization is suitable for the GCC region.

Some recent changes in technologies offer significant opportunities for GCC countries. An example is the direct reduction of iron ore into sponge iron, using natural gas instead of coke. The sponge iron can be reduced to steel in electric arc furnaces, on a very small scale, using inputs of scrap of various qualities. (See Table 1-1.) The heavy use of natural gas and electricity, and the limited minimum efficient scale of the direct reduction method, provide a formidable comparative advantage to the GCC region, which has abundant gas and thermal electricity potential, and can import ore cheaply.[6]

Smelting alumina into aluminum through electrolytic processes is again energy-intensive, as well as scale-efficient at low output levels, and capital-intensive. Moreover, the GCC region is advantageously located near Africa (particularly Guinea, which has over a third of the world reserves of bauxite). Similar advantages may be found in the smelting of copper and alloys.

Marketing opportunities in the Arab World, and in neighbouring Asian and African countries, are considerable. With a proper allocation of investment to activities in these regions, the GCC countries might bring into being a formidable procurment-distribution network, with benefit both to the GCC countries themselves and to the neighbouring regions.

Processing need not be confined to the region's own mineral deposits or other domestic resources. Raw materials or semi-finished goods may be imported for further domestic processing, and the products then used for home consumption or exported. This might be particularly desirable in the case of products that require intensive combinations of capital and energy and can be produced efficiently with relatively small-scale operations.

Traditionally, industrial development has been viewed from what may be called a "horizontal perspective". That is to say, attention has been focussed on activities as they relate to products classified by major sectors of production or by categories of subsequent use. Analyses of manufacturing are usually carried out in terms of light and heavy industry, or in terms of consumer and capital goods. However, this approach makes it difficult to distinguish different activities within a given branch of industry. On the other hand, an examination of resource-based industrialization requires a "vertical perspective": activities must be examined according to their stage of processing -- in terms of primary, semi-finished and finished goods -- rather than according to the characteristics of the final product.

The adoption of a "vertical perspective" is also motivated by the fact that differences in the manufacturing structures of industrialized and semi-industrialized countries are not fully explained by the fact that production of certain branches of industry takes place in the former but not in the latter. Industrial activities are usually reported in the same industrial branches in both developed and developing countries. It is important to go below the levels of broad production categories to ascertain the extent to which one set of processing activities is found in a developed country while a different set is found in a developing country, even though both are subsumed under the same general heading in an industrial classification system. Thus, the patterns of industrial processing, and not just the presence or absence of particular branches of industry, are important distinguishing features in comparisons of the stages of industrialization between developed and developing countries. Moreover, the distinction is especially important for the purpose of identifying industrial activities for promotion and development. One of the principal objectives of this study, therefore, is to analyse commodity imports in terms of their level of processing, and thereby to focus attention on those activities which the GCC might wish to encourage as part of an overall program of industrialization, diversification, and economic integration.

1-5. PLAN OF THE STUDY

The remaining two chapters of Part One provide material intended to serve as general background for the subsequent parts of the study: the broad features of the GCC economy and of the individual economies of the six member states are discussed and the trading and other economic relationships that exist among the member states and between the GCC region and the rest of the world are examined, based on available trade, financial, and other data. Part Two is concerned with the GCC resource base and its utilization. Each of seven basic classes of natural resources is considered separately and in detail. The classes include water resources, agricultural resources, fisheries, oil and gas, metallic minerals, and non-metallic minerals. In addition, a chapter is devoted to the possibilities of extracting recoverable resources from waste material. Part Three of the study draws on the previous chapters, as well as other material, to provide an assessment of the options open to the GCC for a coordinated program of industrialization. A comprehensive and detailed taxonomy of materials and commodities is provided, with attention given to the nature of the processes by which they are produced -- the degrees of complexity and of capital and energy intensity, in particular -- to the present extent of importation into the GCC region, and to other features of special relevance. Based on this taxonomy, and on the material presented in Parts One and Two, a set of industrial activities which appear to have high potential for development is identified and discussed.

The intention is that this set would provide the basis for initiating the detailed technical studies and economic evaluations that would be necessary before actual decisions could be made and specific investment projects undertaken. The study concludes, in Part Four, with a summary of what has been attempted and a statement of the principal findings and of the recommendations to which they give rise.

FOOTNOTES TO CHAPTER 1

1. Oil was found in large quantities in Kuwait in 1938 but production did not begin until 1946. In Qatar, oil was first discovered in 1940 and the first exports were shipped in 1949. Saudi oil exports did not start until 1946, and then only on a very modest scale, despite the fact that oil had been discovered in Dammam in 1938. In the United Arab Emirates, production began in Abu Dhabi in 1962, in Dubai in 1969, and in Sharjah in 1974. In Oman, production did not begin until 1967.
2. The GCC is not inconsistent with the Arab Common Market and other Arab economic agreements, in the same sense that the Benelux Custom Union was not inconsistent with the EEC.
3. The Riyadh declaration of February 4, 1981, which established the GCC, calls for "... the realization of the maximum level of coordination, complementarity and integration among the six member countries in all fields."
4. See J. Stern, "The Employment Impact of Industrial Projects: A Preliminary Report," Discussion Paper No. 14, Harvard Institute for International Development, April 1976.
5. See M. Roemer, G. Tidrick and D. Williams, "The Range of Strategic Industries in Tanzanian Industry", Journal of Development Economics, Vol. 3, No. 3 (October, 1976).
6. See T.R. Stauffer, "Energy-Intensive Industrialization in the Arabian Gulf: A New Ruhr without Water?" Harvard University, Centre For Middle East Studies, 1975.

TABLE 1-1: MINIMUM ECONOMIC PLANT CAPACITY

Type of plant	Minimum economic capacity (tons per year)
Alumina refinery	400,000
Aluminum smelter	60,000-80,000
Copper smelter	100,000
Copper refinery (primary)	60,000
Steel mill (integrated)	1,000,000
Steel mill (direct reduction, electronic furnace)	100,000
Tin smelter	15,000
Lead smelter, refinery	30,000
Zinc smelter	30,000
Nickel smelter (sulphide)	25,000
Nickel refinery	25,000
Ferro-nickel plant (oxide)	10,000-15,000

SOURCE: Compiled from various sources, including the World Bank, the United Nations Industrial Development Organization, and the Centre for Natural Resources, Energy and Transport.

NOTE: Considerable economies of scale (up to 20 per cent per unit of product) can still be achieved at larger capacities (for example, up to 5,000,000 tons per year for integrated steel mills, and up to 1,000,000 for alumina refineries).

CHAPTER 2

AN OVERVIEW OF THE ECONOMY OF THE GCC REGION

2-1. INTRODUCTION

This chapter is concerned with the overall economy of the GCC region and with the differences, similarities, and relationships among the individual economies of its six member states. The aim of the chapter is to provide a broad picture of relevant economic and associated demographic and environmental characteristics that will serve as background to more detailed analyses in the subsequent chapters. We begin by providing a synoptic view of the region's natural resource base. This is followed by a discussion of its human resources. The production patterns of the region are then examined, including the industrial composition of its gross domestic product and the allocation of the product among major expenditure categories, as reflected in national accounting estimates. Particular attention is given to the role of oil exports as the driving force behind economic expansion and to the trading relationships of the GCC countries, both among themselves and with the rest of the world.

2-2. THE NATURAL RESOURCES OF THE REGION

A brief statement of the more prominent natural-resource and related environmental features of the GCC region is provided in Table 2-1. The table includes a summary description of energy resources, water resources, agriculture, fisheries, and metallic and non-metallic minerals, and takes note of some other basic natural features.

The most prominent class of resources, obviously, is energy resources. These include oil and natural gas in great abundance. Indeed, the GCC region represents the main source of crude oil exports for the rest of the world. Its vast natural gas reserves have scarcely been exploited to date, but offer great potential for the future. A major advantage of the region is that its geology makes the processes of extracting oil and gas relatively cheap. Low costs of transportation give the oil industry a further natural advantage in world markets, although this advantage is not one that is shared with gas. In addition to oil and gas as sources of cheap energy for industrial and household consumption, the region has a vast potential for the future harnessing of solar energy, owing to its climatic characteristics.

If energy resources provide the potential for industrialization, water resources represent one of the most important "bottlenecks" -- one of the chief factors operating to impede the realization of that potential. Some production processes are more water-intensive than others, of course, but in general both industrialization and agricultural expansion imply a rising level of water utilization, and the scarcity of cheap water may become an increasingly severe constraint on economic development.

Estimates for the region as a whole indicate a surplus of water supply over demand for the next few years but the aggregates mask the existence of scarcities in many parts of the region. The largest fraction of total supply is in certain areas of Saudi Arabia; elsewhere the region is characterized generally by potential shortages. Moreover, water is largely a shared resource in the most fundamental sense: the hydrogeology of the region is such that attempts to increase the supply in one area or country may damage or reduce the supply in another. Water is critical to the economy of the region and the management and development of water resources are basic concerns for the GCC if it is to have a coordinated and effective policy of economic development.

The potential for developing a strong agricultural base in the GCC region is restricted by the limited availability of arable land. Most of the arable land that is available is located in Saudi Arabia and Oman, and even here the productivity of the land is heavily dependent on the controlled supply of water. Any expansion would necessitate more extensive use of irrigation, and would require careful planning and management, inasmuch as improper irrigation techniques run the risk of soil degradation and permanent loss of land from production. On the other hand, there is considerable potential for efficient production by the use of controlled-environment techniques in the growing of fruits and vegetables and in the raising of livestock, especially poultry.

The stocks of fish in the GCC region are largely concentrated in the Arabian Sea, and it is here that there exists the greatest potential for further development of fisheries. The stocks in the Arabian Gulf and the Gulf of Oman are not as large, but nevertheless substantial, and they too offer some development potential. Stocks in the Red Sea are relatively quite small, and of comparatively minor importance from the point of view of the region as a whole.

The metallogenesis of the GCC region is associated mainly with crystalline basement outcrops. By far the largest share of known deposits of metallic minerals are located in Saudi Arabia, although there are deposits also in Oman, and to a lesser extent in the United Arab Emirates. Aside from copper in Oman, there appears to be no significant exploitation of the region's metallic mineral deposits at the present time. Metals for which extraction is possible include copper, iron, zinc, aluminum, gold and silver.

Non-metallic mineral deposits are distributed more generally throughout the GCC region. Present production from these deposits includes gypsum, limestone, clays, silica sand, gravel, and various types of ornamental stone. There are significant known deposits of phosphate rock in Saudi Arabia which have not been exploited to date, and which offer potential for future production.

The forest resources of the region are, of course, negligible. We note this in Table 2-1 simply as a reminder that the region is necessarily wholly dependent on imports for all wood materials and finished products.

A broad definition of "natural resources" would include the locational advantage of the region associated with its access to ocean transportation. The location of the GCC countries on major maritime trade routes is an important feature of the regional economy from the point of view of its present and prospective trading relations with the rest of the world.

Two other general features of the regional environment that are of relevance in a stock-taking of natural advantages and disadvantages are noted in Table 2-1. The first has to do with the capacity of the Arabian Gulf to absorb industrial and urban waste. An unavoidable concomitant of industrialization and urbanization is an increased volume of waste that must be discharged into the environment in one form or another. The Arabian Gulf is the natural "sink" for such discharge. However, the Gulf is shallow, highly saline, and has high water temperature and slow circulation, all of which makes its capacity for absorbing waste relatively low. The problem of waste disposal is a major one for industrial nations around the world, and clearly it will be increasingly important for those of the GCC region as it moves along its path of economic development.

The second environmental feature of note is that lack of vegetation makes the soil subject to erosion in much of the GCC region, with implications for the utilization and preservation of land that introduce problems not encountered in many other parts of the world in which industrial economies have developed.

2-3. HUMAN RESOURCES

The population of the GCC Region is estimated at somewhere around 12.5 million in 1981. The population is not easily measured with accuracy in economic and geographic conditions such as those that obtain within much of the region, and the quality of the population data is therefore variable and uncertain. Nevertheless, the 12.5 figure at least indicates an order of magnitude.

Saudi Arabia has by far the largest share of the regional total -- about 69 percent in 1981, based on the estimates shown in Table 2-2. Almost 12 percent live in Kuwait, and about 7 percent in each of Oman and the United Arab Emirates. Bahrain has some 3 percent and Qatar about 2 percent. Saudi Arabia clearly dominates the region in terms of both geographic area and size of population.

The overall population of the region has grown rapidly within the past decade. The growth has been faster in some member countries than in others, but nevertheless rapid in all. The average rate was about 4 percent per annum between 1971 and 1981, and roughly the same in both halves of the decade. The population of the region, which was about 8.5 million at the start of the decade, increased by some 4 million, or almost half of its original size. By the standards of the industrialized nations of the world, that is a very large proportionate increase. All other factors aside, the growth of the population alone indicates the magnitude by which the consumption requirements and the human resources of the region have been expanding.

The rapid growth in population has been attributable in large part to the inflows of foreign workers on which the region has relied in order to expand its labour force at a pace consistent with its expanding economy. Data relating to foreign-born population in the region are fragmentary, and often out of date. However, there is no question that the proportions are generally high. A 1974 estimate sets the proportion at about 12 percent in Saudi Arabia, but undoubtedly it is much higher than that today, although probably still below the levels in other GCC member countries. Figures for Kuwait and Bahrain in 1981 indicate proportions of 60 and 32 percent, respectively. In the United Arab Emirates the proportion is still greater; even in 1975 it is estimated to have been close to 70 percent, and all indications are that it has risen markedly since then. The implications of such large foreign-born components within the population are profound from a social point of view, as the countries of the region well recognize.

The territory of the GCC region is large and much of it is sparsely populated. Overall, the density of population is estimated to have been 5 persons per square kilometer in 1981. An estimate of the rural and urban proportions sets them at 67 and 33 percent, respectively. This is based on 1976 data, and almost certainly the urban proportion has risen in the past several years. Nevertheless, a large fraction of the regional population lives in rural areas at the present time. This is due to the low urban proportion in Saudi Arabia (estimated at about 21 percent in 1976, although one suspects that this figure may be an underestimate), and in lesser degree to the much lower proportion in Oman (only about 5 percent).

The other four member countries have quite high urban proportions, as indicated in Table 2-2.

The population of the GCC region is a relatively young one. Again the data are of variable quality and recency, but the picture is clear in broad outline. Data for Saudi Arabia in 1974 indicate that some 47 percent of the population were under 15 years of age, and only 11 percent were 50 or over. One may wonder whether the under-15 proportion is overstated somewhat, especially as an indicator of the present-day situation. Even so, it is apparent that the age distribution is heavily tipped towards the younger end. In Bahrain, Kuwait, and Qatar both the under-15 and 50-and-over proportions are lower, but the generalization still holds; the proportion under 15 ranges from about 33 to about 40 percent in those three countries, based on the figures recorded in Table 2-2, and the proportion 50 and over ranges from 5 to a little less than 9 percent. In the United Arab Emirates the proportion under 15 was only about 28 percent, as of 1975, and the proportion 50 and over was some 7 percent. Thus almost two-thirds of the UAE population were in the "prime" working age range between 15 and 50. In large measure this reflects the very high proportion of foreign working population in the UAE.

Women account for somewhat less than half of the overall population of the GCC region, and in some of the member countries the proportion is well below half. In Qatar the proportion is 40 percent, and in the UAE only 31 percent, based on 1976 data. Again, the low UAE figure reflects the very large (and preponderately male) foreign-worker component.

Levels of education have obviously not been high in the GCC region, on average, if the levels common in industrialized areas of the world are used as a standard. It is estimated that in Saudi Arabia, in 1978, about 58 percent of the population 10 years of age and over were illiterate. In each of Bahrain and Kuwait the proportion was about 36 percent, and in the UAE it was 31. (Figures for Oman and Qatar were not available.) The high average rate of illiteracy in Saudi Arabia is a reflection, in part, of the large rural component of its population. There have been major investments in their educational sectors by the GCC countries in recent years, and substantial improvements in educational participation rates. The level of education has therefore been rising, on average, and the rate of illiteracy has been falling. The rates presented in Table 2-2 thus are poor indicators of the current situation with regard to the younger cohorts within the population, and hence with regard to new labour force entrants. Nevertheless, they do reflect an important characteristic of the existing population as a whole and, more importantly (from the point of view of technologically demanding industrialization processes), of the present-day working population.

Data relating directly to the labour force are presented in Table 2-3. The quality of these data is also somewhat uncertain, and caution is warranted in interpreting them. More attention should be paid, therefore, to the broad picture of the availability and characteristics of manpower indicated by the table than to its details.

The total labour force of the region is estimated at 4.1 million in 1980, or about 33 percent of the total population. Saudi Arabia, of course, contributed by far the largest proportion of the total -- about 62 percent, which is somewhat less than its share of the population. About 10 or 11 percent were contributed by each of Kuwait and the UAE, and another 9 percent by Oman. Bahrain and Qatar, the least populous of the six member countries, contributed about 5 and 3 percent, respectively.

The extent of reliance on foreign workers shows up clearly in Table 2-3. In 1975, about 85 percent of the labour force of the UAE were foreign born, and the proportion in Qatar was about 81 percent in the same year. Bahrain had the smallest foreign proportion shown in the table -- about 38 percent (in 1976). Kuwait had about 70 percent (in 1976), Saudi Arabia about 43 percent (in 1975), and Oman an estimated 50 percent (in 1980). These are very high proportions indeed, and the more so when one considers that most of the estimates are several years out of date, and that, if anything, the current proportions are likely to be higher. The desire to expand their economies rapidly and vigorously created, in the countries of the GCC region, a demand for labour which could be satisfied only by opening the gates wide to migrant workers. There are probably very few areas of the world where one would find work forces with such high foreign content.

The labour force of the region, like the population, is comparatively young. Age-distribution data are not available for all countries, and once again such data as are available are out of date. But the general features are clear. In Saudi Arabia (with some three-fifths of the total GCC labour force), about 60 percent of all workers were under the age of 35, in 1977. In the UAE the proportion was even higher -- 68 percent, in 1975. In Bahrain and Kuwait (the only other countries for which age data are shown in Table 2-3), the proportions were 54 and 56 percent, respectively.

A striking difference between the GCC labour force and the labour forces of the industrialized nations of the world, generally, is the extremely low rates of female participation. Of the five countries for which data are shown in Table 2-3, Kuwait had the largest proportion of women in its labour force, and that was only about 12 percent in 1975. Bahrain had a 9 percent proportion in 1979, and Saudi Arabia a 6 percent proportion. In Qatar and the UAE the proportions were even lower -- roughly 3 percent in each country. The reasons, of course, are cultural, and therefore quite understandable. However, in considering strategies for economic development, and in making comparisons with industrialized nations, it is important to note that the GCC region has this particular constraint on its ability to expand its industrial productive capacity through the recruitment of workers from within the domestic population.

2-4. INCOME, PRODUCTION, AND EXPENDITURE PATTERNS

Basic national accounting data relating to income, production, and expenditures are provided in Tables 2-4 to 2-22. Tables 2-4 to 2-12 provide estimates of gross domestic product, by country and sector of origin, for the years 1971, 1976, and 1981, together with some associated percentage distributions. The GDP figures on which these tables are based are expressed in U.S. dollars (for comparability) and are at current prices. Table 2-13 provides indexes of gross domestic product at constant (1970) prices, together with associated growth rates, by sector, for the GCC Region as a whole over the period 1960-79. Finally, Tables 2-14 to 2-22 provide estimates of expenditures on gross domestic product by category (consumption, investment, exports, imports) and country, in current U.S. dollars, accompanied by corresponding percentage distributions.

We turn first to Table 2-6 and note that the total gross domestic product of the GCC Region is estimated to have been about 210 billion U.S. dollars in 1981, expressed at purchasers' prices. The phenomenal growth in the value of the region's output is indicated by the corresponding totals for 1971 and 1976 (Tables 2-4 and 2-5): in

1971, the value of the GDP was only about 11 billion U.S. dollars; by 1976, it had risen to about 79 billion dollars, an increase of more than six-fold; and by 1981, it had reached the 210 billion dollar level just noted, or about nineteen times the level of a decade earlier. The driving force behind the growth in the value of production was, of course, the sharp rise in crude oil prices in the 1970's and (in much lesser degree) the overall increases in the annual volume of oil extracted within the region. That the massive increase in the region's oil revenues induced very rapid expansion in the economy at large is evidenced by a fourteen-fold increase in the value of manufacturing production between 1971 and 1981, a fifteen-fold increase in the service-producing sector, and a forty-two-fold increase in construction.

The population was increasing quite rapidly too over this period. Nevertheless, the value of GDP per capita is estimated to have risen from about $1,300, in 1971, to a little under $17,000, in 1981. This increase -- and the associated increase in the aggregate GDP -- should be kept in proper perspective. Much of the gain was offset by inflation -- by higher prices of consumption and investment goods to purchasers in the GCC countries -- but the remaining very large real increase should be interpreted with care as well. To the extent that it was the result of selling off some of the region's oil supply in world markets, or of consuming oil domestically, the increase might better be viewed as a conversion of wealth: oil under the ground may be regarded as a (very large) component of the region's national wealth, and the extraction of it implies the using up or transformation of this form into some other form of wealth, or into current consumption. In this sense, the annual income or production figures based on conventional national accounting procedures may be misleading; they may overstate the levels of income in a fundamental sense -- in the sense, that is, of sustainable levels of income.

The sharp rise in crude oil prices in the 1970's might thus be regarded as a wealth effect, rather than as a "true" shift in income level. The price rise implied a drastic upward revaluation of the GCC region's underground resources -- its stock of natural capital -- if one uses current prices to do the valuation. But in a deeper sense, the present value of the underground wealth depends not just on current prices but on expectations about future prices, and these, in turn, depend on expectations about future world demand and supply conditions, including the effects of technological change and price-induced energy substitution. For present purposes, the main point to be emphasized is that conventional national accounting measures (such as those in our tables) may overstate the national income by including what might better be regarded as wealth conversion than as a flow of income or production that is necessarily sustainable into the long-term future. It would seem highly desirable to develop a set of national accounts for the region in which allowance is made for resource depletion. This is a difficult task and can yield only rough approximations. Nevertheless, even crude estimates which incorporate such an allowance would be more realistic than the conventional ones, which do not.

The percentage distributions of the gross domestic product among sectors within the GCC region as a whole, and within each of the member countries, are shown for 1971, 1976, and 1981 in Tables 2-7 to 2-9. The dominance of oil is immediately evident from the high proportions of GDP originating in the sector labeled "mining, quarrying, and oil extraction." In 1971, about 61 percent of the region's GDP, at current prices, came from this sector; by 1976, the proportion had risen to about 65 percent; in 1981, at 63 percent, it had fallen a little, but was still higher than a decade earlier. In five of the six member countries the proportions were either higher in 1981 than in 1971, or unchanged. The exception was Bahrain, where there had been a very sharp drop -- from about 72 percent in 1971 to 37 percent in 1976, and then to 33 percent by 1981 -- as the result of a marked reduction in the rate of oil extraction.

An examination of the 1981 country distributions contained in Table 2-9 indicates a remarkable feature: with one exception (again Bahrain) the intra-country sector distributions look quite similar, in very broad terms. The proportions of GDP value originating in "mining, quarrying, and oil extraction" for Kuwait, Oman, Qatar, Saudi Arabia, and the UAE all lie between 62.7 and 69.2 percent; the proportions in all commodity-producing sectors combined lie in an even narrower range -- from 76.9 to 79.3 percent; and the proportions in all service-producing sectors combined lie between 20.7 and 23.1 percent. Given the reliability of the data, one could almost say (in this very broad sense) that the proportionate distribution shown for any one of the five countries would serve as an estimate for any one of the others. The similarity is the more remarkable when one recalls the pronounced differences in population size, rural-urban distributions, and other demographic or labour-related characteristics discussed previously.

As one might expect, the differences from one country to another are seen to be greater when one looks at Table 2-9 in more detail. Bahrain and Kuwait are estimated to have had the largest proportions of GDP value originating in manufacturing in 1981 -- 9.5 percent in the first and 6.1 in the second -- while the lowest proportion, 1.0 percent, is recorded for Oman. Agriculture ranges from 0.2 percent in Kuwait to 2.1 percent in Bahrain. Construction ranges from 2.7 percent in Kuwait to

11.0 in Saudi Arabia, and to 13.2 percent in Bahrain. Other sectors show similar kinds of variation.

Percentage distributions among countries for each production sector are shown in Tables 2-10 to 2-12. The dominant size of Saudi Arabia in 1981 is reflected in the distribution of total GDP, and in all of the sector distributions as well: the Saudian Arabian economy produced 65 percent of the region's GDP in that year, about 65 percent of its crude oil, some 64 percent of its manufacturing output, and so on. The UAE accounted for about 15 percent of the total GDP and Kuwait for 12 percent.

A comparison of the distributions for 1981 (Table 2-12) with those for 1971 (Table 2-10) is revealing, and indicates again the significance of oil production for the interpretation of the conventional GDP measures. In 1971, Kuwait and Saudi Arabia each produced about two-fifths of the value of crude oil output of the GCC Region. Kuwait's share of the total GDP was about 35 percent in 1971, and Saudi Arabia's about 46 percent. By 1981, Kuwait had scaled down its level of oil production very sharply in order to lengthen the life of its underground reserves; as noted, its share of total GDP had therefore fallen to only 12 percent, while Saudi Arabia's had increased to 65 percent. This highlights again the need for care in interpreting the conventional national accounting income and production figures; the marked shift in the relative shares of the two countries was much more the result of differences in the rates of conversion of their natural underground wealth than of fundamental changes in their abilities to generate sustainable flows of income.

Indexes of the region's GDP, in real or constant-dollar terms, are shown by sector in Table 2-13 for the period 1960-79, together with annual growth rates for selected intervals within this period. The indexes have base 100.0 in 1970. Overall, the real GDP increased by 479 percent between 1960 and 1979, and by 149 percent between 1970 and 1979. These increases are far less than those in the current-dollar levels discussed above, but still large. They imply an annual rate of growth of 9.7 percent over the entire 1960-79 period, and of 10.7 percent over the 1970-79 period. Such rates are very rapid by any standard.

The increases in real production of crude oil are implicit in the indexes for mining, quarrying, and oil extraction, since oil accounts for almost all of the output of this sector. From 1970 to 1979, the sector index rose by 89 percent, or at a rate of 7.3 percent per annum. Next to agriculture, fishing, and trapping, this is the smallest rate shown for any sector in the table: manufacturing increased at 10.6 percent per annum over the same period, electricity, gas, and water at 15.3 percent, construction at 16.1 percent, wholesale and retail trade at 15.7 percent, and transportation and communication at 17.7 percent. An annual rate of increase of the order of 7 percent in oil extraction is still high, of course, and it has important implications for the pace at which the known underground petroleum reserves are being exhausted. However, it is far less than the rate of growth of production value, since the latter reflects the very sharp price increases that occurred in the 1970's, as well as the lesser increases in physical volume.

The disposition of the gross domestic product, as evidenced by the national expenditure accounts of the GCC Region and its member countries, is recorded in Tables 2-14 to 2-16, again for the years 1971, 1976, and 1981. Corresponding percentage distributions among categories of expenditure within countries, and among countries within categories of expenditure, are shown in Tables 2-17 to 2-22. The expenditure estimates underlying these tables are again in current U.S. dollars.

Bahrain has had annual deficits on its international trade account -- large ones, relative to its GDP in 1971 and 1976, though quite small in 1981 -- as these tables indicate. However, in all of the other countries, and in the region as a whole, there have been huge surpluses, reflecting the revenues generated by shipments of oil exports at sharply increased world prices. In 1981, the balance-of-trade surplus for the GCC Region as a whole was equal to about 35 percent of the region's total value of GDP; for the five individual surplus countries, the percentages ranged from 33 (in Saudi Arabia) to 68 (in Qatar). It is, of course, these massive trade surpluses that have provided the funds for large-scale investment and rapid economic expansion in the GCC Region. Indeed, a major problem within the region has been (and continues to be) the management of the huge volume of capital funds generated by oil exports, and the rate at which the economies of the region can effectively absorb these funds in the form of investments in new plant and equipment, urban construction developments, improved economic infrastructure, and so on, or in the form of enhanced levels of consumption by the population at large. The inability to absorb the funds at anything like the rates at which they have accumulated has led to holdings of financial assets abroad of unprecedented magnitude, and these, in turn, have generated new investment revenue, and hence further accumulation of foreign holdings. The sheer size of portfolios of investments abroad has itself created problems because of the implications that any sudden shift in these portfolios might have for the international financial community, for the stability of the industrialized nations, and hence for the security of investments and the maintenance of markets for future oil exports.

That the economies of the GCC countries are overwhelmingly dependent on foreign trade is a point that scarcely needs emphasis. However, the statistical evidence in the national accounts tables should at least be noted. For the region as a whole, exports represented some 72 percent of the total gross domestic product in 1981, and imports some 37 percent. In Bahrain, exports represented 120 percent of the GDP, and imports 121 percent. (These figures reflect the substantial re-export component of imports into Bahrain.) Of the remaining five countries, Saudi Arabia had the lowest ratio of exports to GDP, at 68 percent, and Qatar had the highest, at 91 percent. Imports in 1981 represented about 23 percent of GDP in Qatar; in the other countries the proportion was in no case below 32 percent.

Investment, in the sense of physical capital creation, absorbed the equivalent of 24.5 percent of the total GCC gross domestic product in 1981, as reported in Table 2-19. As reported in Table 2-22, about 70 percent of all such investment within the region took place in Saudi Arabia, while the United Arab Emirates accounted for about 16 percent, and Kuwait for about 8.

The trading relations of the GCC countries are predominantly with the non-GCC world; flows of imports and exports within the region itself are generally small. Bahrain represents somewhat of an exception, inasmuch as it imports a substantial volume of oil from Saudi Arabia and has served as a point of transhipment for goods from abroad that are destined to other GCC countries, most notably to the United Arab Emirates. In the main, though, there is comparatively little direct economic interconnection among the GCC countries at the present time. This is a point of considerable importance since much closer trading relationships might have to be developed among the member countries if a coordinated program of industrialization and intra-regional specialization in production were to be initiated by the GCC. The existing patterns of trade are examined in detail in the next chapter.

TABLE 2-1: RESOURCE BASE AND RELATED ENVIRONMENTAL FEATURES OF THE GCC REGION: AN OVERVIEW

Energy Resources	-- abundant oil and natural gas reserves -- main source of world exports of crude oil -- natural gas reserves so far little exploited; great potential -- low costs of production of oil and gas for geological reasons -- low transport cost in the case of oil -- excellent potential for development of solar energy -- energy resources provide main source of financial capital for future industrialization
Water Resources	-- GCC region characterized by relative scarcity of water supply -- largest part of water supply is in Saudi Arabia; imbalances of supply and demand throughout the GCC region -- water is largely a shared resource -- critical element for further economic development
Agriculture	-- very limited availability of arable land; most of arable land is in Saudi Arabia and Oman and is heavily dependent on irrigation -- irrigation is vital but soil degradation may result from use of improper procedures and scarcity of water may be a limiting factor -- high potential for controlled-environment production of fruits and vegetables -- high potential for controlled-environment production of livestock, especially poultry
Fisheries	-- largest fish stocks and potential for increased utilization are in the Arabian Sea; stocks and potential in the Arabian Gulf and the Gulf of Oman are smaller but substantial; stocks in the Red Sea are relatively quite small.

(Continued...)

TABLE 2-1: (Continued)

Metallic Minerals	-- metallogenesis in the GCC region is associated mainly with crystalline basement outcrops -- Saudi Arabia has largest part of known deposits; some known deposits also in Oman, and to a lesser extent in UAE -- principal metals that could be extracted from known deposits include copper, iron, zinc, aluminum, gold, and silver -- significant exploitation is confined to copper deposits in Oman
Non-Metallic Minerals	-- known deposits are distributed generally throughout the GCC region -- minerals now produced include gypsum, limestone, clays, silica sand, gravel, and various types of ornamental stone -- there are also significant known deposits of phosphate rock located in Saudi Arabia which might be exploited
Forest Resources	-- negligible
Transportation	-- countries of the GCC region are located on major maritime trade routes
Other Environmental Features	-- Arabian Gulf is shallow, highly saline, has high water temperature, and slow circulation; hence absorptive capacity is relatively low for industrial and urban waste -- lack of vegetation makes soil subject to wind erosion in much of the GCC region

TABLE 2-2: SIZE AND SELECTED CHARACTERISTICS OF THE POPULATION OF THE GCC REGION, BY COUNTRY, VARIOUS YEARS

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Total population ('000)							
- 1971	220	790	670	120	6,380	280	8,460
- 1976	270	1,060	790	180	7,400	620	10,320
- 1981	400	1,440	920	230	8,650	850	12,490
Annual growth rate (%)							
- 1971-81	6.2	6.2	3.2	6.7	3.1	11.7	4.0
- 1971-76	4.2	6.1	3.3	8.4	3.0	17.2	4.1
- 1976-81	8.2	6.3	3.1	5.0	3.2	6.5	3.9
Country as % of region, 1981	3.2	11.5	7.4	1.8	69.3	6.8	100.0
Density (pop./km^2), 1981	597.6	80.8	3.9	20.2	4.0	10.3	5.0
Urban as % of total, 1976	77.7	88.4	5.3	88.7	20.8	84.0	33.0
Female as % of total, 1976	47.2	46.0	49.2	40.0	49.4	30.8	47.7
Foreign as % of total (latest year)	32.0 (1981)	60.0 (1981)	n.a.	61.8 (1975)	11.8 (1974)	69.5 (1975)	n.a.
% Illiterate, pop. 10+, 1978	36.1	36.5	n.a.	n.a.	57.9	31.0	n.a.
% Age distribution (latest year)	(1981)	(1975)		(1970)	(1974)	(1975)	
-- under 15	32.9	39.6	n.a.	36.8	46.7	28.2	n.a.
-- 15-49	58.4	55.4	n.a.	56.4	42.3	64.5	n.a.
-- 50+	8.7	5.0	n.a.	6.9	11.1	7.3	n.a.

TABLE 2-3: SIZE AND SELECTED CHARACTERISTICS OF THE LABOUR FORCE OF THE GCC REGION, BY COUNTRY, 1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Labour force ('000), 1981	190	430	370	110	2,550	450	4,100
Country as % of region, 1981	4.6	10.5	9.0	2.7	62.2	11.0	100.0
Foreign as % of total	37.5	69.7	50.0	81.1	43.0	84.8	n.a.
(latest year)	(1976)	(1976)	(1980)	(1975)	(1975)	(1975)	
% Age distribution (latest year)	(1971)	(1975)			(1977)	(1975)	
-- under 25	24.6	21.4	n.a.	n.a.	24.9	26.4	n.a.
-- 25-34	29.4	35.0	n.a.	n.a.	34.9	41.2	n.a.
-- 35-49	30.7	34.1	n.a.	n.a.	28.2	25.7	n.a.
-- 50+	15.3	9.4	n.a.	n.a.	12.0	6.8	n.a.
Females as % of total	9.3	11.6	n.a.	2.9	6.0	3.4	n.a.
(latest year)	(1979)	(1975)		(1970)	(1980)	(1975)	

TABLE 2-4: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY, 1971 (MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	3	9	40	7	235	20	314
Mining, quarrying, and oil extraction	188	2,549	178	254	2,815	718	6,702
Manufacturing	6	152	1	11	436	31	637
Electricity, gas, and water	4	26	1	5	66	15	117
Construction	5	94	49	25	224	72	469
Total, commodity-producing sectors	206	2,830	269	303	3,778	856	8,242
Trade, restaurants, and hotels	14	253	7	30	239	86	629
Transportation, storage, and communication	3	89	5	30	330	83	540
Other services	39	708	21	37	685	105	1,595
Total, service-producing sectors	56	1,050	33	97	1,253	274	2,763
Total GDP at producers' prices	262	3,880	301	400	5,031	1,130	11,004
Import duties					78		78
Total GDP at purchasers' prices	262	3,880	301	400	5,109	1,130	11,082
GDP per capita (at producers' prices)	1,189	4,912	449	3,333	801	4,036	1,310

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-5: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY, 1976
(MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	27	35	62	23	449	109	705
Mining, quarrying, and oil extraction	458	8,633	1,536	1,717	31,189	8,198	51,731
Manufacturing	142	786	12	31	2,315	150	3,436
Electricity, gas, and water	10	64	14	17	43	79	227
Construction	138	419	240	316	4,491	1,508	7,112
Total, commodity-producing sectors	776	9.937	1,864	2,104	38,487	10,045	63,213
Trade, restaurants, and hotels	105	988	146	216	1,751	1,031	4,237
Transportation, storage, and communication	86	248	74	105	1,155	501	2,169
Other services	284	1,959	311	304	5,470	1,452	9,780
Total, service-producing sectors	475	3,195	530	625	8,376	2.984	16,185
Total GDP at producers' prices	1,251	13,132	2,394	2,729	46,863	13,030	79,399
Import duties				-25	-255	-120	-400
Total GDP at purchasers' prices	1,251	13,132	2,394	2,704	46,608	12,910	78,999
GDP per capita (at producers' prices)	6,015	12,389	3,031	15,021	6,298	20,822	7,655

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-6: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY, 1981 (MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	85	62	134	47	1,648	235	2,211
Mining, quarrying, and oil extraction	1,350	17,030	4,549	3,996	86,191	20,075	133,191
Manufacturing	391	1,531	64	237	5,937	1,189	9,349
Electricity, gas, and water	30	98	45	73	96	368	710
Construction	544	675	361	555	15,175	2,790	20,100
Total, commodity-producing sectors	2,401	19,396	5,153	4,908	109,047	24,656	165,561
Trade, restaurants, and hotels	358	1,420	365	514	6,220	2,580	11,457
Transportation, storage, and communication	281	416	188	211	5,323	1,058	7,477
Other services	1,074	3,979	870	662	16,963	3,328	26,876
Total, service-producing sectors	1,713	5,815	1,423	1,387	28,506	6,965	45,809
Total GDP at producers' prices	4,113	25,212	6,577	6,294	137,554	31,621	211,371
Import duties				-92	-509	-464	-1,065
Total GDP at purchasers' prices	4,113	25,212	6,577	6,202	137,045	31,157	210,306
GDP per capita (at producers' prices)	10,283	17,508	7,149	26,965	15,843	36,655	16,838

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-7: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG SECTORS, 1971

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	1.2	0.2	13.3	1.8	4.7	1.8	2.9
Mining, quarrying, and oil extraction	71.8	65.7	59.1	63.5	56.0	63.5	60.9
Manufacturing	2.3	3.9	0.3	2.8	8.7	2.7	5.8
Electricity, gas, and water	1.5	0.7	0.3	1.2	1.3	1.3	1.1
Construction	1.9	2.4	16.3	6.2	4.4	6.4	4.3
Total, commodity-producing sectors	78.6	72.9	89.4	75.8	75.1	75.8	74.9
Trade, restaurants, and hotels	5.3	6.5	2.3	7.5	4.8	7.6	5.7
Transportation, storage, and communication	1.2	2.3	1.7	7.5	6.6	7.4	4.9
Other services	14.9	18.2	7.0	9.2	13.6	9.3	14.5
Total, service-producing sectors	21.4	27.1	11.0	24.2	24.9	24.2	25.1
Total GDP at producers' prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-8: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG SECTORS, 1976

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	2.2	0.3	2.6	0.8	1.0	0.8	0.9
Mining, quarrying, and oil extraction	36.6	65.7	64.2	62.9	66.6	62.9	65.2
Manufacturing	11.4	6.0	0.5	1.1	4.9	1.2	4.3
Electricity, gas, and water	0.8	0.5	0.6	0.6	0.1	0.6	.3
Construction	11.0	3.2	10.0	11.6	9.6	11.6	9.0
Total, commodity-producing sectors	62.0	75.7	77.9	77.1	82.1	77.1	79.6
Trade, restaurants, and hotels	8.4	7.5	6.1	7.9	3.7	7.9	5.3
Transportation, storage, and communication	6.9	1.9	3.1	3.8	2.5	3.8	2.7
Other services	22.7	14.9	13.0	11.1	11.7	11.1	12.3
Total, service-producing sectors	38.0	24.3	22.1	22.9	17.9	22.9	20.4
Total GDP at producers' prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-9: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG SECTORS, 1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Agriculture, forestry, and fishing	2.1	0.2	2.0	0.8	1.2	0.7	1.1
Mining, quarrying, and oil extraction	32.8	67.6	69.2	63.5	62.7	63.5	63.0
Manufacturing	9.5	6.1	1.0	3.8	4.3	3.8	4.4
Electricity, gas, and water	0.7	0.4	0.7	1.2	0.1	1.2	0.3
Construction	13.2	2.7	5.5	8.8	11.0	8.8	9.5
Total, commodity-producing sectors	58.4	76.9	78.4	78.0	79.3	78.0	78.3
Trade, restaurants, and hotels	8.7	5.6	5.6	8.2	4.5	8.2	5.4
Transportation, storage, and communication	6.8	1.6	2.9	3.4	3.9	3.4	3.5
Other services	26.1	15.8	13.2	10.5	12.3	10.5	12.7
Total, service-producing sectors	41.6	23.1	21.6	22.0	20.7	22.0	21.7
Total GDP at producers' prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-10: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1971

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total
Agriculture, forestry, and fishing	1.0	2.9	12.7	2.2	74.8	6.4	100.0
Mining, quarrying, and oil extraction	2.8	38.0	2.7	3.8	42.0	10.7	100.0
Manufacturing	0.9	23.9	0.2	1.7	68.4	4.9	100.0
Electricity, gas, and water	3.4	22.2	0.9	4.3	56.4	12.8	100.0
Construction	1.1	20.0	10.4	5.3	47.8	15.4	100.0
Total, commodity-producing sectors	2.5	34.3	3.3	3.7	45.8	10.4	100.0
Trade, restaurants, and hotels	2.2	40.2	1.1	4.8	38.0	13.7	100.0
Transportation, storage, and communication	0.6	16.5	0.9	5.6	61.1	15.4	100.0
Other services	2.4	44.4	1.3	2.3	43.0	6.6	100.0
Total, service-producing sectors	2.0	38.0	1.2	3.5	45.4	9.9	100.0
Total GDP at producers' prices	2.4	35.3	2.7	3.6	45.7	10.3	100.0
Import duties					100.0		100.0
Total GDP at purchasers' prices	2.4	35.0	2.7	3.6	46.1	10.2	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-11: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1976

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total
Agriculture, forestry, and fishing	3.8	5.0	8.8	3.3	63.7	15.5	100.0
Mining, quarrying, and oil extraction	0.9	16.7	3.0	3.3	60.3	15.8	100.0
Manufacturing	4.1	22.9	0.3	0.9	67.4	4.4	100.0
Electricity, gas, and water	4.4	28.2	6.2	7.5	18.9	34.8	100.0
Construction	1.9	5.9	3.4	4.4	63.2	21.2	100.0
Total, commodity-producing sectors	1.2	15.7	3.0	3.3	60.9	15.9	100.0
Trade, restaurants, and hotels	2.5	23.3	3.5	5.1	41.3	24.3	100.0
Transportation, storage, and communication	4.0	11.4	3.4	4.8	53.3	23.1	100.0
Other services	2.9	20.0	3.2	3.1	55.9	14.9	100.0
Total, service-producing sectors	2.9	19.7	3.3	3.9	51.8	18.4	100.0
Total GDP at producers' prices	1.6	16.5	3.0	3.4	59.0	16.4	100.0
Import duties				6.2	63.8	30.0	100.0
Total GDP at purchasers' prices	1.6	16.6	3.0	3.4	59.0	16.3	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-12: GROSS DOMESTIC PRODUCT OF THE GCC REGION, BY SECTOR OF ORIGIN AND COUNTRY: PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total
Agriculture, forestry, and fishing	3.8	2.8	6.1	2.1	74.5	10.6	100.0
Mining, quarrying, and oil extraction	1.0	12.8	3.4	3.0	64.7	15.1	100.0
Manufacturing	4.2	16.4	0.7	2.5	63.5	12.7	100.0
Electricity, gas, and water	4.2	13.8	6.3	10.3	13.5	51.8	100.0
Construction	2.7	3.4	1.8	2.8	75.5	13.9	100.0
Total, commodity-producing sectors	1.4	11.7	3.1	3.0	65.9	14.9	100.0
Trade, restaurants, and hotels	3.1	12.4	3.2	4.5	54.3	22.5	100.0
Transportation, storage, and communication	3.8	5.6	2.5	2.8	71.2	14.1	100.0
Other services	4.0	14.8	3.2	2.5	63.1	12.4	100.0
Total, service-producing sectors	3.7	12.7	3.1	3.0	62.2	15.2	100.0
Total GDP at producers' prices	1.9	11.9	3.1	3.0	65.1	15.0	100.0
Import duties				-8.6	-47.8	-43.6	-100.0
Total GDP at purchasers' prices	2.0	12.0	3.1	2.9	65.2	14.8	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-13: INDEX NUMBERS OF GROSS DOMESTIC PRODUCT OF THE GCC REGION AT CONSTANT PRICES, BY SECTOR OF ORIGIN (BASE YEAR 1970=100)

Year	Agriculture, forestry, & fishing	Mining quarrying, and oil extraction	Manufac-turing	Electricity, gas, & water	Construc-tion	Wholesale & retail trade	Transport & communi-cation	Other	Total gross domestic product
1960	69	40	36	25	44	44	30	53	43
1963	88	51	46	50	59	54	44	67	55
1965	92	63	54	64	71	65	56	81	67
1970	100	100	100	100	100	100	100	100	100
1971	103	117	113	110	116	110	113	125	117
1972	106	135	120	119	104	121	133	132	129
1973	109	153	135	130	115	140	183	150	145
1974	116	154	169	143	150	178	225	166	159
1975	125	146	169	138	211	220	225	183	167
1976	133	154	191	181	252	286	288	219	192
1977	138	158	214	219	324	349	353	240	212
1978	153	161	232	297	376	345	408	259	225
1979	157	189	248	361	383	371	432	284	249
Annual average percentage growth rates									
1960-65	5.9	9.5	8.4	20.7	10.0	8.1	13.3	8.9	9.3
1965-70	1.7	9.7	13.1	9.3	7.1	9.0	12.3	4.3	8.3
1970-75	4.6	7.9	11.1	6.7	16.1	17.1	17.6	12.8	10.8
1975-79	5.9	6.7	10.1	27.2	16.1	14.0	17.7	11.6	10.5
1960-79	4.4	8.5	10.7	15.1	12.1	11.9	15.1	9.2	9.7
1970-79	5.1	7.3	10.6	15.3	16.1	15.7	17.7	12.3	10.7

TABLE 2-14: EXPENDITURES ON GROSS DOMESTIC PRODUCT, 1971 (MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	230	1,179	51	70	1,429	153	3,112
Public consumption	59	487	63	69	847	150	1,675
Total consumption	289	1,666	114	139	2,276	303	4,787
Investment	18	364	86	59	608	306	1,441
Exports of goods and services (X)	285	2,574	198	311	3,385	957	7,710
Imports of goods and services (M)	330	724	97	109	1,160	437	2,857
Balance of trade (X-M)	-45	1,850	101	202	2,225	520	4,853
Total GDP (at purchasers' prices)	262	3,880	301	400	5,109	1,130	11,082

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-15: EXPENDITURES ON GROSS DOMESTIC PRODUCT, 1976 (MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	842	3,522	340	176	6,771	1,947	13,598
Public consumption	243	1,479	705	452	8,182	1,176	12,237
Total consumption	1,085	5,001	1,045	628	14,953	3,122	25,834
Investment	290	2,172	930	699	9,722	4,284	18,097
Exports of goods and services (X)	1,629	10,234	1,596	2,209	34,075	9,134	58,877
Imports of goods and services (M)	1,753	4,275	1,177	833	12,143	3,630	23,811
Balance of trade (X-M)	-124	5,959	419	1,376	21,932	5,503	35,065
Total GDP (at purchasers' prices)	1,252	13,132	2,394	2,704	46,608	12,910	79,000

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-16: EXPENDITURES ON GROSS DOMESTIC PRODUCT, 1981 (MILLIONS OF CURRENT U.S. DOLLARS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	2,920	8,374	942	281	23,935	6,429	42,881
Public consumption	667	3,641	1,332	623	31,989	3,259	41,511
Total consumption	3,587	12,015	2,274	904	55,924	9,688	84,392
Investment	553	4,007	1,621	1,078	35,883	8,296	51,438
Exports of goods and services (X)	4,951	19,472	5,032	5,625	93,522	23,259	151,861
Imports of goods and services (M)	4,977	10,283	2,351	1,406	48,284	10,085	77,386
Balance of trade (X-M)	-26	9,189	2,681	4,219	45,238	13,174	74,475
Total GDP (at purchasers' prices)	4,113	25,211	6,577	6,202	137,045	31,157	210,305

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-17: EXPENDITURES ON GROSS DOMESTIC PRODUCT: PERCENTAGE DISTRIBUTIONS AMONG CATEGORIES, 1971

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	87.8	30.4	16.9	17.5	28.0	13.5	28.1
Public consumption	22.5	12.5	20.9	17.3	16.6	13.3	15.1
Total consumption	110.3	42.9	37.9	34.8	44.6	26.8	43.2
Investment	6.9	9.4	28.6	14.7	11.9	27.1	13.0
Exports of goods and services (X)	108.8	66.3	65.8	77.7	66.3	84.7	69.6
Imports of goods and services (M)	126.0	18.7	32.2	27.2	22.7	38.7	25.8
Balance of trade (X-M)	-17.2	47.7	33.6	50.5	43.5	46.1	43.8
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-18: EXPENDITURES ON GROSS DOMESTIC PRODUCT: PERCENTAGE DISTRIBUTIONS AMONG CATEGORIES, 1976

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	67.3	26.8	14.2	6.5	14.5	15.1	17.2
Public consumption	19.4	11.3	29.4	16.7	17.6	9.1	15.5
Total consumption	86.7	38.1	43.6	23.2	32.1	24.2	32.7
Investment	23.2	16.5	38.9	25.9	20.9	33.2	22.9
Exports of goods and services (X)	130.1	77.9	66.7	81.7	73.1	70.7	74.5
Imports of goods and services (M)	140.0	32.5	49.2	30.8	26.1	28.1	30.1
Balance of trade (X-M)	-9.9	45.4	17.5	50.9	47.0	42.6	44.4
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: **Figures in this table may not add to totals or subtotals because of rounding.**

TABLE 2-19: EXPENDITURES ON GROSS DOMESTIC PRODUCT: PERCENTAGE DISTRIBUTIONS AMONG CATEGORIES, 1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	71.0	33.2	14.3	4.5	17.5	20.6	20.4
Public consumption	16.2	14.4	20.3	10.1	23.3	10.5	19.7
Total consumption	87.2	47.6	34.6	14.6	40.8	31.1	40.1
Investment	13.4	15.9	24.7	17.4	26.2	26.6	24.5
Exports of goods and services (X)	120.4	77.2	76.5	90.7	68.2	74.7	72.2
Imports of goods and services (M)	121.0	40.8	35.8	22.7	35.2	32.4	36.8
Balance of trade (X-M)	-0.6	36.4	40.8	68.0	33.0	42.3	35.4
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-20: **EXPENDITURES ON GROSS DOMESTIC PRODUCT:** PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1971

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	7.4	37.9	1.6	2.3	45.9	4.9	100.0
Public consumption	3.5	29.1	3.8	4.1	50.6	9.0	100.0
Total consumption	6.0	34.8	2.4	2.9	47.6	6.3	100.0
Investment	1.2	25.3	6.0	4.1	42.2	21.2	100.0
Exports of goods and services (X)	3.7	33.4	2.6	4.0	43.9	12.4	100.0
Imports of goods and services (M)	11.6	25.3	3.4	3.8	40.6	15.3	100.0
Balance of trade (X-M)	-0.9	38.1	2.1	4.2	45.8	10.7	100.0
Total GDP (at purchasers' prices)	2.4	35.0	2.7	3.6	46.1	10.2	100.0

NOTE: Figures in this table may not add to totals or subtotals because of rounding.

TABLE 2-21: EXPENDITURES ON GROSS DOMESTIC PRODUCT: PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1976

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	6.2	25.9	2.5	1.3	49.8	14.3	100.0
Public consumption	2.0	12.1	5.8	3.7	66.9	9.6	100.0
Total consumption	4.2	19.4	4.0	2.4	57.9	12.1	100.0
Investment	1.6	12.0	5.1	3.9	53.7	23.7	100.0
Exports of goods and services (X)	2.8	17.4	2.7	3.7	57.9	15.5	100.0
Imports of goods and services (M)	7.4	18.0	4.9	3.5	51.0	15.2	100.0
Balance of trade (X-M)	-0.4	17.0	1.2	3.9	62.6	15.7	100.0
Total GDP (at purchasers' prices)	1.6	16.6	3.0	3.4	59.0	16.3	100.0

TABLE 2-22: EXPENDITURES ON GROSS DOMESTIC PRODUCT: PERCENTAGE DISTRIBUTIONS AMONG COUNTRIES, 1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Private consumption	6.8	19.5	2.2	0.7	55.8	15.0	100.0
Public consumption	1.6	8.8	3.2	1.5	77.1	7.8	100.0
Total consumption	4.2	14.2	2.7	1.1	66.3	11.5	100.0
Investment	1.1	7.8	3.1	2.1	69.8	16.1	100.0
Exports of goods and services (X)	3.3	12.8	3.3	3.7	61.6	15.3	100.0
Imports of goods and services (M)	6.4	13.3	3.0	1.8	62.4	13.0	100.0
Balance of trade (X-M)	-0.0	12.3	3.6	5.7	60.7	17.7	100.0
Total GDP (at purchasers' prices)	2.0	12.0	3.1	2.9	65.2	14.8	100.0

SOURCE NOTES FOR TABLES IN CHAPTER 2

TABLE 2-2:

Population totals and growth rates are based on data contained in GCC, National Accounts, 1970-1981. Land area figures used in calculating densities are taken from Europa Publications Limited, The Middle East and North Africa, 1981-82, with the exception that the area figure for Oman is the midpoint of the estimated range provided in Richard F. Nyrop, Area Handbook for the Persian Gulf States (1977). Urban and female percentages are based on data in ECWA, Statistical Indicators of the Arab World for the Period 1970-1978. Illiteracy percentages are based on data in Arab Fund, Annual Arab Report, 1981. Foreign population percentages are based on data from the following sources: Bahrain -- 1981 Census; Kuwait -- projection from 1975 Population Census, as shown in Kuwait Central Statistical Office, Annual Statistical Abstract, 1981; Qatar -- ECWA, The Population Situation in the ECWA Region: Qatar (1980); Saudi Arabia -- ECWA, Statistical Abstract of the Region of the Economic Commission for Western Asia, 1970-1979; UAE -- ECWA, The Population Situation in the ECWA Region: United Arab Emirates (1980). Population age distributions are from the following sources: Bahrain -- 1981 Census; Kuwait -- 1975 Population Census, as reported in CSO, Annual Statistical Abstract, 1981; Qatar -- ECWA, The Population Situation in the ECWA Region: Qatar (1980); Saudi Arabia -- ECWA, Statistical Abstract of the Region of the Economic Commission for Western Asia, 1970-1979; UAE -- ECWA, The Population Situation in the ECWA Region: United Arab Emirates (1980).

TABLE 2-3:

Labour Force totals and country distributions for 1981 are estimates obtained by applying recent labour force-population ratios to the 1981 total population figures reported in Table 2-2. (In the case of Oman the ratio is assumed to be .4, which is approximately the unweighted average for the other five countries of the GCC Region.) Foreign labour force percentages are based on data from the following sources: Bahrain and Kuwait -- ECWA, *Statistical Abstract of the Region of the Economic Commission for Western Asia, 1970-1979*; Oman -- Sultanate of Oman Development Council, *The Second Five-Year Plan, 1981-1985*; Qatar, Saudia Arabia, and UAE -- Arab Planning Institute and International Labour Organization, *Seminar on Population, Employment and Migration in the Arab Gulf States*, Kuwait, December 1978. Age and female percentages are from the following sources: Bahrain and Kuwait -- ECWA, *Statistical Abstract of the Region of the Economic Commission for Western Asia, 1970-1979*; Qatar -- *The Population Situation in the ECWA Region: Qatar* (1980) (female percentage only); Saudi Arabia and UAE -- ECWA, *Statistical Indicators of the Arab World for the Period 1970-1978*; except that the female percentage for Saudi Arabia is from Saudi Arabia Ministry of Planning, *Third Development Plan, 1980-1985*.

TABLES 2-4 TO 2-22:

With the exception of Table 2-13, all figures in these tables are based on data contained in GCC, *National Accounts, 1970-1981*; figures in Table 2-1 are from ECWA, *National Accounts Studies Bulletin No. 4, Gross Domestic Produ National Disposable Income, and Consolidated Accounts Statistics of the ECWA Countries* (October 1981).

CHAPTER 3

INTRA-REGIONAL AND EXTERNAL ECONOMIC RELATIONSHIPS

3-1. INTRODUCTION

The contacts that the GCC countries have had with the rest of the world have increased enormously in recent years, and their economic relationships with other countries have become much stronger and more prominent. The root cause, of course, has been the vast increase in their wealth and in their strategic importance, as the world has become increasingly dependent on them for critical energy supplies.

The purpose of this chapter is to discuss economic contacts with other nations, and to document the extent of those contacts, and the growth in their importance, where possible. Again here, as in the previous chapter, there are data problems. Nonetheless, an overall picture of the tremendous practical importance of these contacts emerges from the variety of data which have been analysed.

In section 3-2, the focus is on trade in commodities. Based on available data, classified according to the standard international trade classification system, we are able to get a picture of the extent of commodity trade within the region, and between the region and the rest of the world. We consider the extent of trade which takes place between the GCC countries and other Arab countries, as well as trade with the major industrial countries of the world and with non-Arab developing countries.

The considerable surplus on trade account has, of course, resulted from the fact that the growth in oil revenues has generally outstripped the growth of imports. In consequence, the region has accumulated substantial holdings of foreign assets. The information that is available on such foreign holdings is limited, and relates largely to certain financial assets. It is presented and discussed in section 3. Part of the surplus on the trade account has been used to provide economic assistance to other developing countries, and part leaves the region in the form of transfers by foreign workers to their families living abroad. These matters are also discussed in section 3.

As noted in the previous chapter, there has been a very large influx of foreign workers attracted by the high wages associated with the rapid economic expansion of the area. Many of these workers have come from other Arab countries, but increasingly they have come also from non-Arab countries, most notably Pakistan and India. Their presence makes rapid expansion possible, but it also necessitates the maintenance of facilities to house, feed, transport, and otherwise support them, and thereby places greater pressure on the economic system. In addition, their sheer numbers are cause for concern from a social point of view, inasmuch as they often represent cultural values and aspirations which are foreign to the area.

3-2. COMMODITY TRADE

As has already been indicated, trade between countries in the GCC region is very limited in scope, and involves mostly the re-export of goods imported from abroad. The reason is simple: the countries are basically very similar; they extract and export their reserves of oil wealth and import almost everything else. Hence the possibility of trade within the region, other than that involving re-exports, depends on the development of domestic industries. While it is likely that such trade has increased in recent years as the national economies have become somewhat more diversified, it remains the case that trade with the rest of the world overwhelmingly dominates trade within the region.

We consider first the extent and nature of the trade flows involving the GCC countries, the types of commodities traded, and their countries of origin and destination. The discussion here is based largely on data obtained from two related sources: the IMF publication, Direction of Trade Statistics Yearbook, 1982 (hereafter, DOTS Yearbook) and the UNIDO data tapes, COMTRADE. The first source provides data on the distribution by trade partners of total merchandise exports and imports for 154 countries for the years 1975 through 1981, while the second provides similar data at a commodity level of detail, based on the standard international trade classification (SITC).

We start by considering the overall commodity trade flows, as reported in the DOTS Yearbook. Information relating to the 1981 total commodity flows within the GCC region and between each member country and the rest of the world as a whole is provided by Tables 3-1 and 3-2. (Similar tables for each of the years 1975 to 1981, and also tables showing row and column percentage calculations, are provided in Appendix B.) Measures of trade flows can be based either on export data or import data, or on some combination of the two. Table 3-1 is based mainly on the import data for each of the member countries, along with each country's total reported exports. Figures for imports from and exports to the "rest of the world" are calculated residually. Table 3-2, on the other hand, is based mainly on export data.

As a comparison of these two tables makes clear, some substantial differences can arise, depending on whether one starts mainly from export or from import data. However, for present purposes the major observations are largely independent of which table is used. In both cases the trade flows involving each country with others in the region are far smaller than those with nations outside the region. The only exception is Bahrain, which receives a large fraction of its imports from Saudi Arabia, mostly in the form of crude petroleum for refining and for use in aluminum smelting, and a large fraction of whose exports are re-exports, going especially to the UAE. In all other cases, the exports to other GCC countries represent less than 4 percent of total exports in 1981. On the import side, Saudi Arabia received about 1.2 percent of its imports from other GCC countries, and Kuwait 3.2 percent. The figures for the other countries were somewhat higher, including especially Bahrain, as already noted. Even though suitable data are not available on re-exports, it seems likely that, aside from the special link between Saudi Arabia and Bahrain, the bulk of the trade within the GCC involves re-exports of goods brought in from abroad.

Further summary information on the total volume of exports emanating from the GCC region over the period 1975-1981 is provided in Table 3-3. (Once again, more detailed information is provided in Appendix B.) In this table are reported the total current dollar value of exports from the region (measured exclusive of exports to other GCC countries), and the percentage distribution of those exports by country of origin. There was a spectacular growth in the current value of exports, especially towards the end of the period, reflecting, in large part, the rise in oil prices which took place at that time. It is once again evident that Saudi Arabia dominates, accounting for about 60 percent of total exports in each year between 1975 and 1979, more than 67 percent in 1980, and over 71 percent in 1981. The recent rise in its share reflects Saudi Arabia's decision to continue to increase oil production at a time when some of the other countries, most notably Kuwait, were cutting back. Kuwait is potentially the second largest oil producer in the region, although recently it has reduced its production below that of the UAE.

A similar tabulation showing total imports and their percentage distribution within the GCC is provided in Table 3-4. The total value of imports also increased very rapidly over the period 1975-1981, following the increase in exports, but the value of commodity imports remained well below that of commodity exports. In fact, by 1980, and again in 1981, the commodity exports of the GCC region were estimated to exceed its imports by more than 100 billion dollars. Saudi Arabia has been the largest importer, and its proportion of the total has grown over the period, presumably reflecting in part the opening of extensive new port facilities of its own, and hence the reduction in the volume of imports received as re-exports from other GCC countries. The growth may also reflect a relatively more ambitious attempt at rapid economic development.

The percentage shares of exports going to industrial and developing nations are shown in Table 3-5, for each country in each year from 1975 to 1981. Within the group of developing countries, we show separately the non-GCC Arab region. (Additional data relating to these exports, as well as more detailed area information, are provided in Appendix B.) The bulk of exports -- about 70 percent -- go to the industrial nations and most of the rest goes to the developing nations. (In addition, a small amount goes to the USSR and Eastern Europe, and to countries not specified.) The non-GCC Arab countries received about 2 percent of the GCC region exports in recent years. There are some differences among the countries of the region in terms of the destinations of their exports, but the patterns are generally similar.

Most of the import trade is also with the industrial nations, as is clear from Table 3-6: the industrial nations collectively provided between two-thirds and three-quarters of the goods imported into the GCC region in each of the years shown in the table, and the proportion has grown in recent years. Again there are some small differences among the individual countries.

In summary, the picture which emerges from the trade estimates published in the DOTS Yearbook is that the total value of commodity exports from the GCC countries has grown very rapidly in recent years, and that this has led to rapid increases in imports, although the value of commodity imports has remained far below that of exports. While the value of trade has grown, it has continued to be mostly with the industrialized nations, which are the destination for about 70 percent of the exports and the origin for a somewhat larger fraction of the imports.

Information relating to the commodity composition of the trade flows is available from the UNIDO data tapes, COMTRADE, as previously noted, and we now turn to a consideration of that. COMTRADE provides data at the commodity level, according to the standard international trade classification (SITC). These data are generally comparable, in the aggregate, to those already discussed, but there are some important gaps, as noted below.

An indication of the extent of coverage for the period 1978-1981 is given in Table 3-7, where the number of trading partners for which data are available is shown. It is perhaps not surprising that Saudi Arabia should have the largest number of trading partners, in view of its size, followed by Kuwait. It is also not surprising that the imports, which are much more diversified in character, should involve many more trading partners than the exports. However, it is clear that much information is missing. Data are available for Bahrain and Kuwait for the years 1978, 1979, and 1980, but not for 1981. For Oman also, we are without import data for 1981, but we are also without export data for 1978. In the case of Qatar we have import data for all four years, but export data for only the first two, while for Saudi Arabia we have both import and export data for all years. Finally, in the case of the UAE we have no export data at all, and import data only for the year 1979. Thus we do not have both import and export data for any one year for all of the GCC countries. The data appear most complete for 1979, and we have, therefore, emphasized that year in some of the discussion below.

There are undoubtedly many deficiencies associated with this data source, mostly the result of underlying deficiencies in the basic processes of data collection. However, we can compare the total figures for imports and exports from the COMTRADE tapes with the DOTS Yearbook estimates as a check on the overall consistency of the two sources. This comparison is made in Table 3-8 which provides the estimates of total trade flows, as drawn from the two data sources, in millions of U.S. dollars, for each year from 1978 through 1981, and also presents the COMTRADE totals as a percent of the DOTS totals. It is evident from these comparisons that the two data sources are generally consistent for those years and countries for which comparisons are possible. The major exception involves the exports of Oman: the COMTRADE data have omitted most exports included in the DOTS totals. On closer inspection, it turns out that virtually all of petroleum and petroleum products -- which account for almost all of Oman's exports -- have been omitted! However, since Oman's petroleum exports account for only a small fraction of the exports of the GCC region, this data source remains useful for purposes of forming a picture of the commodity composition of trade for the region as a whole.

Tables C-1 through C-8 in Appendix C present commodity imports and exports for major categories (i.e., at the one-digit level of the SITC system) for each of the years 1978 through 1981. Even though data relating to particular countries within the region are not available for some years, those data that are available are aggregated to obtain a total for the region as a whole. It must be emphasized, of course, that the total figures are simply the sum of the figures available. Two totals are provided for the GCC region: the "gross" total includes trade within the region, whereas the "net" one excludes such trade. In Tables C-9 through C-16, the imports and exports within each category are expressed as a percentage of the category (gross) total, and in Tables C-17 through C-24 they are expressed as a proportion of the country or region total. In Tables C-25 through C-48 the same basic tables are provided again, this time indicating the area of origin of each of the major categories of imports and the area of destination in the case of exports.

Clearly a great wealth of information is contained in the tables, of Appendix C, and the tables are included for reference purposes. Some major aspects of the data for the region as a whole are summarized in Tables 3-9 and 3-10. Table 3-9 presents data relating to net exports and Table 3-10 presents data relating to net imports, in both cases for the year 1979. In the first column of each of these tables, the trade in each of ten major commodity groups is presented as a percentage of the region's total trade.

The rows of Table 3-9 (excluding the first number in each row) represent the country-of-destination distributions, in percentage form, of the various commodity exports; similarly, the rows of Table 3-10 represent the country-of-origin distributions of imports. The year 1979 is chosen because, as noted, the data for that year are most complete. It should also be noted that the percentage distributions, as presented here, are much less affected than the raw numbers by the errors and omissions in the data.

The extent of dependence on oil is immediately evident from the fact that 97.2 percent of commodity exports in 1979 consisted of "mineral fuels and lubricants". Almost three quarters of such exports went to industrial nations, and almost one quarter to developing nations. Of the other export commodity categories, the most important one is "chemicals", a category in which production in the region is closely linked to the petrochemical industry.

Imports, of course, are much more diversified. Even so, as of 1979 more than 40 percent were in "machinery and transport equipment" and close to a further 40 percent in "manufactured goods" and "miscellaneous manufactured articles", indicating the dependence of the GCC region on the importation of highly processed goods from the industrial countries. Of the remaining 20 percent, half is represented by "food and live animals", reflecting the fact that the region is far from self-sufficient in food.

More detailed information, relating to the 1979 exports and imports of commodities classified at the two-digit level, is provided by Tables 3-11 and 3-12. (Similar tabulations for other years, and corresponding percentage tabulations, are available in Appendix C.) Recall that no detailed export data are available for the UAE, and also that the export data reported for Oman cover only a small fraction of its actual exports. Allowing for these omissions, these more detailed data confirm the earlier observation that the exports consist almost entirely of petroleum and petroleum products; such exports account for 95.3 percent of the total of recorded net exports of the region, and the percentage would probably be even higher if data for the UAE and Oman were available. The next most important export is also in the "fuels" category -- namely, natural and manufactured gas, which accounts for 1.9 percent. Chemicals account for an additional 1.2 percent of exports, and of these, three quarters are classified as "mineral tar and crude chemicals" and one-sixth as manufactured fertilizers. These products, of course, are closely tied to oil and natural gas, and it is to be expected that the volume of such exports will increase markedly in the years ahead, as new facilities now being developed come into production.

With respect to imports, we have already noted that more than 40 percent are accounted for by "machinery and transport equipment". Within this category, non-electric machinery, electrical machinery and appliances, and transport equipment take about equal shares. Within "manufactured goods", which account for 26 percent of net imports, iron and steel account for one quarter, and manufactures of metal for another quarter. Presumably such imports will decline as the volume of domestic production increases in the near future.

3-3. THE FLOW OF INTERNATIONAL PAYMENTS AND THE ACCUMULATION OF FOREIGN ASSETS

As a result of continuing large export surpluses, the GCC region has, for some years, been in the position of sending large volumes of funds, in one form or another, to the rest of the world. Some of these funds have left the region in the form of transfers (official foreign aid, or private transfers made mostly by foreign workers), while others have involved the accumulation of assets abroad.

Unfortunately it has not proved possible to provide balance-of-payments accounts even for all the countries of the region, let alone a consolidated statement for the region as a whole. However, the available data for Saudi Arabia and Kuwait are reported in Tables 3-13 and 3-14. The accounts are divided into current and capital accounts, and the total of one must equal the negative of the total of the other as a result of the concepts underlying their construction.

Consider first the balance of payments statistics of Saudi Arabia, as presented in Table 3-13. As measured in current dollars, the value of merchandise exports increased more than seventeen fold between 1973 and 1980. As expected, the oil sector provided almost all the merchandise exports. The growth in export earnings was not steady, as already noted, but instead reflected the increase in the volume of petroleum exports and, more especially, the large increases in their unit value which took place in 1974, 1979, and again in 1980. A relatively small but important credit on the current account consists of income earned in the export of services of various sorts, and also the earnings on assets held abroad (investment income). We note that the investment income so recorded has increased more than twenty-five fold over the period, from $209 million in 1973 to $5,387 million in 1980.

The debit side of the current account indicates the relatively steadier growth in both merchandise and non-merchandise imports. It represents the flow of funds abroad including payment of management and other fees to foreigners and other items of investment income. In addition, there is shown a very large debit category referred to as "other". It may be that amounts entered here involve largely the government purchase of military supplies and equipment from abroad.

It is interesting to observe the pronounced changes in the overall balance relating to "goods, services, and income". This item increased very sharply in 1974, reflecting the large increase in oil prices at that time. It declined to a lower level during 1975-77, and then fell very sharply in 1978. The fall was arrested only by the further sharp increase in oil prices in 1979, and again in 1980.

The remaining items in the current account relate to current transfers abroad. The first is "private unrequited transfers", representing mostly the amount which foreign workers in Saudi Arabia have sent to their families at home. This amount increased more than ten times during the period 1973-80, and exceeded $4 billion by the end of it. Clearly such transfers represent substantial infusions of funds into the economies of those nations from which the foreign workers come. In addition, the government of Saudi Arabia increased its foreign aid (referred to in the table as "official unrequited transfers") from somewhat less than one-half billion dollars in 1973 to almost $4 billion in 1980.[1]

Overall, the current account was in surplus in every year of the period except 1978. The deficit of that year reflects the especially rapid expansion of development expenditures that was taking place at that time. Possible deficits in 1979 and 1980 were avoided by the increase in oil prices, as already noted.

The capital account reflects a mixture of short-term and long-term capital movements, as well as changes in official holdings of foreign reserves. Long-term capital movements includes direct investment abroad, but it has not been possible to provide this component separately. The total of long-term flows going abroad increased rapidly after 1973, and exceeded $11 billion in 1976. Such flows decreased in 1977, and then again in 1978. In the latter year, the total stock of such capital abroad actually declined according to the figure shown in Table 3-13. However, long-term capital abroad increased again in 1979, and then much more sharply -- by more than $27 billion, -- in 1980. The distinction between long- and short-term capital movements is somewhat arbitrary, and it is therefore interesting to note that there was relatively little change in the two taken together between 1974 and 1979, inclusive: the overall deficit on current account that occurred in 1978 was reflected almost entirely in the $12 billion reduction in official reserve holdings, compared to an increase of almost $2.7 billion the previous year.

Similar data for Kuwait for the years 1975-80 are reported in Table 3-14. As compared to Saudi Arabia, a relatively less rapid growth in both exports and imports is evident, with the difference being most marked in the case of exports between 1979 and 1980. The Kuwaiti government decided to reduce substantially the volume of oil exported at that time, while exports from Saudi Arabia increased. In other respects, however, the accounts of the two countries are broadly similar: large surpluses on trade account have resulted in a substantial accumulation of foreign assets, some portion of which is evident from the large negative balance in the capital account each year. The benefit from such holdings of assets abroad is at least partly reflected in the substantial growth of investment income which shows up on the current account.

As already noted, similar balance-of-payments statistics for other countries in the GCC region are not available, and even if they were we could not aggregate them to obtain regional accounts because we lack requisite information concerning the non-commodity flows between countries within the region. Nonetheless, the available data do leave the impression of the accumulation of a very considerable volume of assets outside the region. Another indication of these asset holdings -- though one which is very incomplete -- is afforded by Table 3-15. It shows the net foreign assets of the central banks and the commercial banks in the GCC region. (The totals for the region include only those countries for which data are available; for this reason, the totals before 1973 are underestimates. Also, the totals have been calculated on the assumption that the foreign asset holdings of each country in the region are held in countries outside the region.) While the figures include the foreign financial asset holdings of individuals that are held through the banking system, they exclude all other asset holdings -- such as the ownership of real estate and of equity capital, as well as of financial assets not registered in the accounts of banks in the GCC region. Thus the figures in Table 3-15 clearly represent underestimates -- and perhaps very substantial underestimates -- of the total of assets held abroad. Even so, the total of recorded foreign asset holdings exceeded $100 billion by 1980 -- or more than $8,000 per member of the GCC population.

3-4. THE ROLE OF MIGRATION

It has already been observed that the rapid growth in expenditures designed to accelerate economic development of countries in the region has been associated with high levels of migration of workers from abroad. The pace of change picked up in the 1960's, with the emphasis on the provision of the infrastructure, and continued throughout the 1970's with policies designed to foster rapid industrialization. In view of the small size of the local workforce, and also of the skill levels available, a substantial influx of foreign workers was a necessary concomitant of rapid development. Thus it was that by the mid 1970's the labour force of the region consisted of approximately equal numbers of foreign and domestic workers. Our purpose now is to present additional information about the national origins and overall numbers of the foreign workers.

Estimates of the numbers of foreign workers in each of the GCC member states in 1975, by country of origin, are provided in Table 3-16. The foreign workers are tabulated under headings "Arab", "Asian", and "All other". It is evident that workers of Arab origin greatly predominate, accounting for more than two-thirds of all foreign workers in the region. (It should be noted that it has not been possible to net out migration within the region; thus "other" Arab workers include those from elsewhere within the GCC region. However, the total number of such workers is thought not to be very large.) The Arab proportion varies substantially from one country to another: it is highest in Saudi Arabia (90.5 percent), and lowest in Oman (12.4 percent). Asian workers account for almost one-quarter of foreign workers in the region, but again the proportion varies considerably, from a high in Oman (83 percent) to a low in Saudi Arabia (4.9 percent). Most Asian workers come from Pakistan or India.[2] Finally, European and American workers account for just over 2 percent of foreign workers in the region as a whole, although they represent more than 15 percent of foreign workers in Bahrain.

In more recent years it seems very likely that the number (and proportions) of foreign workers would have increased, but no detailed estimates comparable to those in Table 3-16 appear to be available. However, some related estimates suggest that the foreign labour in the GCC region, excluding Oman, increased by more than one third between 1975 and 1978, and that the growth came very largely from the non-Arab world.[3]

The large-scale influx of foreign workers has clearly been necessary for the promotion of rapid industrialization. Foreign workers have come at all levels, from unskilled or semi-skilled workers through to those with the highest professional qualifications. Aside from other considerations, they have provided an important channel through which modern technologies have been introduced from abroad.

FOOTNOTES TO CHAPTER 3

1. A recent analysis of such flows from all Arab oil-producing countries is provided in Mohammed Imady, "The Patterns of Arab Economic Aid to Third World Countries, Arab and Non-Arab", an unpublished paper prepared for the Institute of Arab Studies Second International Seminar, June 1982.
2. A study of migration from India to the GCC countries other than Saudi Arabia, and its impact on both sending and receiving areas, is provided in Myron Weiner, "International Migration and Development: Indians in the Persian Gulf", *Population and Development Review*, Vol. 8, No. 1 (March 1982), pp. 1-36.
3. The estimates were appear in *The Interdependence Model*, Volume III, Annex 1, Appendix 7, a volume prepared by ENI (the Ente Nazionale Idrocarburi), based on a seminar on Development through Cooperation, held in Rome, April 1981.

TABLE 3-1: COMMODITY TRADE WITHIN THE GCC REGION AND WITH THE REST OF THE WORLD, 1981

FROM \ TO	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	OTHER GCC	REST OF WORLD	TOTAL EXPORTS
					(MILLIONS OF U.S. DOLLARS)				
BAHRAIN	--	32.3	78.6	33.4	146.3	635.5	926.1	2615.1	3541.2
KUWAIT	5.0	--	4.0	25.0	132.0	411.0	577.0	15984.0	16561.0
OMAN	...	...	--	...	...	...	...	4415.0	4415.0
QATAR	2.6	19.8	1.1	--	69.4	45.9	138.8	3839.3	3978.1
SAUDI ARABIA	2544.0	191.0	19.0	23.0	--	78.0	2855.0	110473.0	113328.0
UNITED ARAB E.	20.0	12.0	272.0	38.0	86.0	--	428.0	20511.0	20939.0
OTHER GCC	2571.6	255.1	374.7	119.4	433.7	1170.4	--	--	--
REST OF WORLD	1814.1	7786.9	1846.1	1451.4	34834.3	8378.6	--	--	--
TOTAL IMPORTS	4385.7	8042.0	2220.8	1570.8	35268.0	9549.0	--	--	--

NOTE: WHERE POSSIBLE, INFORMATION IS TAKEN FROM EXPORT DATA. THE SYMBOL -- INDICATES "NOT RELEVANT." THE SYMBOL ... INDICATES "NOT AVAILABLE."

TABLE 3-2: COMMODITY TRADE WITHIN THE GCC REGION AND WITH THE REST OF THE WORLD, 1981

FROM \ TO	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	OTHER GCC	REST OF WORLD	TOTAL EXPORTS
					(MILLIONS OF U.S. DOLLARS)				
BAHRAIN	--	20.0	76.9	6.7	161.0	525.0	789.6	2751.6	3541.2
KUWAIT	2.1	--	6.7	15.0	145.8	49.0	216.8	16344.2	16561.0
OMAN	...	...	--	...	3.0	...	3.0	4412.8	4415.8
QATAR	2.8	22.0	1.2	--	76.0	51.0	153.0	3825.1	3978.1
SAUDI ARABIA	2797.9	210.0	20.3	25.2	--	85.0	3139.4	110188.6	113328.0
UNITED ARAB E.	22.2	13.0	299.6	42.1	95.0	--	471.9	20467.1	20939.0
OTHER GCC	2825.0	265.0	404.7	89.0	480.0	710.0	--	--	--
REST OF WORLD	1560.7	7777.0	1816.1	1481.5	34788.0	8833.0	--	--	--
TOTAL IMPORTS	4385.7	8042.0	2220.8	1570.8	35268.0	9549.0	--	--	--

NOTE: WHERE POSSIBLE, INFORMATION IS TAKEN FROM IMPORT DATA. THE SYMBOL -- INDICATES "NOT RELEVANT." THE SYMBOL ... INDICATES "NOT AVAILABLE."

TABLE 3-3: EXPORTS FROM THE GCC REGION, TOTAL AND PERCENTAGE DISTRIBUTION AMONG COUNTRIES, 1975-1981

Year	Total (millions of U.S. dollars)	Percentage distribution						
		Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1975	47,563.7	1.1	18.1	2.8	3.7	62.0	12.2	100.0
1976	60,618.6	1.2	16.2	2.5	3.5	62.8	13.8	100.0
1977	66,767.6	1.3	14.6	2.3	3.3	64.5	14.0	100.0
1978	60,859.3	1.2	17.1	2.4	3.7	61.3	14.4	100.0
1979	95,771.0	1.3	19.1	2.2	3.4	60.5	13.6	100.0
1980	151,062.1	1.0	13.4	1.9	2.9	67.1	13.6	100.0
1981	157,838.2	0.6	10.3	2.6	2.4	71.5	12.5	100.0

TABLE 3-4: IMPORTS TO THE GCC REGION, TOTAL AND PERCENTAGE DISTRIBUTION AMONG COUNTRIES, 1975-1981

Year	Total (millions of U.S. dollars)	Percentage distribution						
		Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1975	10,403.9	5.3	22.9	5.1	3.6	37.7	25.4	100.0
1976	16,405.3	5.7	20.2	3.2	4.6	46.6	19.8	100.0
1977	26,365.9	4.1	18.3	2.7	4.3	51.8	18.7	100.0
1978	32,983.0	3.4	13.9	2.3	3.5	61.1	15.8	100.0
1979	39,051.5	3.1	13.1	2.6	3.5	61.3	16.4	100.0
1980	48,656.9	3.0	13.2	2.8	2.8	61.3	16.9	100.0
1981	56,262.6	2.8	13.8	3.2	2.6	61.8	15.7	100.0

TABLE 3-5: EXPORTS FROM THE GCC REGION TO INDUSTRIAL AND DEVELOPING COUNTRIES, PERCENTAGE SHARES, 1975-1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1975							
- industrial	51.7	62.4	83.2	72.1	68.3	92.7	70.4
- developing	22.4	30.2	16.6	26.1	22.0	4.9	21.3
- non-GCC Arab countries	0.0	4.7	...	0.1	1.2	0.0	1.6
1976							
- industrial	35.9	57.7	90.9	75.6	66.5	85.3	67.9
- developing	25.0	28.3	8.9	16.1	22.8	9.3	21.3
- non-GCC Arab countries	0.9	2.2	...	1.2	1.3	0.1	1.3
1977							
- industrial	30.6	58.8	89.2	69.7	69.5	81.3	69.0
- developing	26.3	25.2	10.1	14.4	21.6	13.9	20.7
- non-GCC Arab countries	1.6	2.2	...	2.3	1.6	0.4	1.5
1978							
- industrial	35.8	62.2	93.0	77.4	75.2	75.8	72.6
- developing	32.3	23.0	6.0	21.6	18.6	18.6	19.5
- non-GCC Arab countries	1.7	2.6	0.0	...	1.3	1.7	1.5
1979							
- industrial	21.3	60.0	94.9	73.2	75.7	76.8	71.9
- developing	27.8	27.3	1.2	22.2	19.1	20.5	20.8
- non-GCC Arab countries	1.1	3.5	...	0.0	1.8	2.1	2.1
1980							
- industrial	23.0	50.3	77.6	70.5	75.3	81.0	71.5
- developing	30.1	33.9	15.7	25.7	19.8	16.6	21.5
- non-GCC Arab countries	1.5	4.0	...	0.0	1.9	1.6	2.0
1981							
- industrial	22.5	43.6	83.0	66.7	72.4	77.2	69.1
- developing	30.5	38.0	9.8	28.7	22.6	20.8	23.9
- non-GCC Arab countries	1.2	4.8	...	0.0	2.5	1.7	2.5

NOTE: The symbol ... indicates "not available."

TABLE 3-6: IMPORTS TO THE GCC REGION FROM INDUSTRIAL AND DEVELOPING NATIONS, PERCENTAGE SHARES, 1975-1981

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1975							
- industrial	35.2	77.1	64.9	76.9	63.7	69.0	65.3
- developing	9.6	18.4	14.6	14.4	25.3	20.0	20.0
- non-GCC Arab countries	0.5	3.8	1.1	5.6	18.0	2.1	8.1
1976							
- industrial	41.0	74.9	62.3	78.4	64.3	73.9	66.5
- developing	13.4	20.8	15.2	10.2	20.0	18.9	18.8
- non-GCC Arab countries	0.3	2.3	.4	2.7	12.4	1.3	6.6
1977							
- industrial	39.7	71.8	66.5	81.1	66.4	75.2	67.6
- developing	12.3	23.8	15.0	10.5	16.3	17.6	17.2
- non-GCC Arab countries	0.3	2.2	0.4	2.3	7.6	1.2	4.6
1978							
- industrial	42.3	74.1	63.9	85.5	79.9	75.8	76.0
- developing	11.4	20.7	16.5	11.1	12.8	17.0	14.5
- non-GCC Arab countries	0.6	3.0	0.4	2.5	3.5	1.4	2.8
1979							
- industrial	38.3	72.5	67.5	84.6	79.1	71.9	74.5
- developing	8.7	21.7	13.7	11.5	13.8	17.3	15.0
- non-GCC Arab countries	0.3	2.6	0.5	2.2	3.4	1.1	2.6
1980							
- industrial	32.2	74.1	63.4	77.7	79.6	70.7	73.7
- developing	8.7	20.0	12.8	15.4	14.5	19.6	15.7
- non-GCC Arab countries	0.2	2.3	0.3	2.5	3.2	3.1	2.8
1981							
- industrial	27.7	74.7	67.8	78.9	80.6	70.9	74.0
- developing	7.2	18.8	12.2	14.1	14.3	19.7	15.1
- non-GCC Arab countries	0.1	1.8	0.2	1.8	3.1	2.8	2.6

TABLE 3-7: NUMBER OF TRADING PARTNERS FOR WHICH COMMODITY TRADE DATA ARE AVAILABLE

	Imports				Exports			
	1978	1979	1980	1981	1978	1979	1980	1981
Bahrain	101	111	99	0	58	47	47	0
Kuwait	108	110	110	0	89	93	82	0
Oman	78	82	81	0	0	40	54	72
Qatar	70	71	73	87	29	36	0	0
Saudi Arabia	147	149	149	148	97	104	110	109
UAE	0	113	0	0	0	0	0	0

TABLE 3-8: VALUE OF TOTAL IMPORTS AND EXPORTS AS REPORTED ON THE UNIDO COMMODITY TRADE DATA TAPE (COMTRADE) AND IN THE IMF DIRECTION OF TRADE STATISTICS 1982 YEARBOOK (DOTS)

						Saudi		GCC Region	
		Bahrain	Kuwait	Oman	Qatar	Arabia	UAE	Gross	Net
					(millions of U.S. dollars)				
Imports									
COMTRADE --	1978	2,032.8	4,598.0	947.4	1,184.7	20,177.2	...	28,940.1	27,587.1
	1979	2,477.5	5,203.8	1,246.4	1,424.4	24,384.3	6,419.1	41,155.5	38,645.9
	1980	3,479.3	6,554.2	1,732.0	1,395.2	29,957.1	...	43,117.8	40,154.9
	1981	...	...	2,288.2	...	35,041.5	...	37,329.7	36,292.7
DOTS --	1978	2,043.9	4,604.0	947.3	1,183.9	20,349.0	5,385.0	34,513.1	32,983.0
	1979	2,485.0	5,198.0	1,246.5	1,425.2	24,257.0	6,971.0	41,582.7	39,051.5
	1980	3,483.8	6,533.0	1,732.0	1,439.8	30,166.0	8,848.0	52,202.6	48,656.9
	1981	4,385.7	8,042.0	2,220.8	1,570.8	35,268.0	9,549.0	61,036.3	56,262.6
Exports									
COMTRADE --	1978	1,867.2	10,427.5	...	2,367.9	40,715.3	...	55,377.9	53,329.6
	1979	2,470.5	18,415.9	120.9	3,598.0	63,419.2	...	88,024.6	85,209.4
	1980	3,794.8	20,434.6	144.3	...	109,112.6	...	133,486.4	129,340.5
	1981	...	...	276.5	...	119,913.1	...	120,189.7	116,965.0
DOTS --	1978	1,625.8	10,466.0	1,512.1	2,318.0	37,914.0	9,125.0	62,960.9	60,859.3
	1979	2,491.9	18,449.0	2,165.7	3,406.2	58,751.0	13,652.0	98,915.8	95,771.0
	1980	3,610.0	20,402.0	3,295.0	4,464.9	102,113.0	21,662.0	155,546.9	151,062.1
	1981	3,541.2	16,561.0	4,415.8	3,978.1	113,328.0	20,939.0	162,763.1	157,838.2
					(percentages)				
Imports (COMTRADE/DOTS)									
	1978	99.5	99.9	100.0	100.1	99.2	...	83.9	83.6
	1979	99.7	100.1	100.0	99.9	100.5	92.1	99.0	99.0
	1980	99.9	100.3	100.0	96.9	99.3	...	82.6	82.5
	1981	...	...	103.0	...	99.4	...	61.2	64.5
Exports (COMTRADE/DOTS)									
	1978	114.8	99.6	...	102.2	107.4	...	88.0	87.6
	1979	99.1	99.8	5.6	105.6	107.9	...	89.0	89.0
	1980	105.1	100.2	4.4	...	106.9	...	85.8	85.6
	1981	...	...	6.3	...	105.8	...	73.8	74.1

NOTE: The symbol ... indicates "not available."

TABLE 3-9: COMMODITY EXPORTS (NET) FROM THE GCC REGION, BY MAJOR CATEGORIES AND AREA OF DESTINATION, PERCENTAGE DISTRIBUTIONS, 1979

		Destination							
		Industrial nations							
	% of Total	Total	U.S.	Japan	Other	Developing nations	Centrally planned economies	Other	Total
Total	100.0	72.4	13.1	19.9	39.3	25.2	0.0	2.3	100.0
Food and live animals	0.1	7.0	0.2	4.1	2.7	90.0	0.0	3.1	100.0
Beverages and tobacco	0.0	0.3	0.0	0.0	0.3	64.8	0.4	34.5	100.0
Crude materials, inedible, except fuels	0.1	7.8	0.4	1.6	5.9	89.8	1.0	1.4	100.0
Mineral fuels and lubricants	97.2	73.2	13.5	19.9	39.9	24.6	0.0	2.1	100.0
Animal and vegetable oils and fats	0.0	0.0	0.0	0.0	0.0	99.3	0.0	0.7	100.0
Chemicals	1.2	72.6	0.0	36.1	36.5	25.0	0.0	2.4	100.0
Manufactured goods	0.5	24.4	0.5	11.6	12.2	56.6	0.1	19.0	100.0
Machinery and transport equipment	0.7	13.2	2.9	0.4	9.9	72.3	0.0	14.5	100.0
Miscellaneous manufactured articles	0.1	18.6	1.2	0.1	17.3	72.9	0.4	8.0	100.0
Not classified	0.0	72.4	13.1	19.9	39.3	25.2	0.0	2.3	100.0

TABLE 3-10: COMMODITY IMPORTS (NET) TO THE GCC REGION, BY MAJOR CATEGORIES AND AREA OF ORIGIN, PERCENTAGE DISTRIBUTIONS, 1979

		Origin							
		Industrial nations							
	% of Total	Total	U.S.	Japan	Other	Developing nations	Centrally planned economies	Other	Total
Total	100.0	79.2	17.5	17.0	44.7	18.4	1.5	0.9	100.0
Food and live animals	11.0	53.0	11.6	2.5	38.9	43.6	2.9	0.6	100.0
Beverages and tobacco	1.7	88.5	31.4	9.4	47.7	10.7	0.6	0.2	100.0
Crude materials, inedible, except fuels	1.6	44.3	8.8	1.2	34.4	50.0	4.1	1.2	100.0
Mineral fuels and lubricants	1.0	62.8	19.1	0.7	43.0	36.0	0.2	1.1	100.0
Animal and vegetable oils and fats	0.4	36.0	10.5	0.9	24.6	62.9	1.0	0.1	100.0
Chemicals	4.1	87.9	14.3	3.0	70.6	11.0	0.6	0.5	100.0
Manufactured goods	26.0	74.3	9.8	23.1	41.4	22.1	2.8	0.8	100.0
Machinery and transport equipment	41.1	93.8	26.5	20.6	46.7	4.9	0.6	0.8	100.0
Miscellaneous manufactured articles	12.6	67.9	9.5	15.5	42.9	30.0	1.2	0.9	100.0
Not classified	0.4	65.5	9.4	2.8	53.3	2.9	0.0	31.6	100.0

TABLE 3-11: COMMODITY EXPORTS FROM THE GCC REGION TO THE REST OF THE WORLD: DETAILED CATEGORIES, 1979

	COMMODITY GROUP	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	GCC REGION	
								GROSS	NET
		(MILLIONS OF U.S. DOLLARS)							
0	FOOD AND LIVE ANIMALS	.9	60.1	19.8	...	36.2	...	116.2	55.9
00	LIVE ANIMALS	.0	2.1	.1	...	.4	...	2.6	.9
01	MEAT AND MEAT PREPARATIONS	.1	8.7	.8	...	.2	...	9.8	1.4
02	DAIRY PRODUCTS	.1	2.5	1.5	...	1.4	...	5.6	1.8
03	FISH AND FISH PREPARATIONS	.0	8.2	4.5	...	1.[illegible]	...	14.4	7.4
04	CEREAL AND CEREAL PREPARTAIONS	.2	10.8	3.4	...	3.[illegible]	...	18.3	11.2
05	FRUIT AND VEGETABLES	.2	11.3	7.8	...	18.5	...	37.8	16.7
06	SUGAR,SUGAR PREPARATIONS AND HONEY	.0	4.4	.0	...	5.3	...	9.7	6.6
07	COFFEE,TEA,COCOA,AND SPICES	.2	9.4	1.4	...	3.4	...	14.5	8.7
08	FEEDING STUFF FOR ANIMALS	.0	1.5	.3	...	.3	...	2.1	.3
09	MISCELLANEOUS FOOD PREPARATIONS	.0	1.2	.0	...	.9	...	2.2	1.0
1	BEVERAGES AND TOBACCO	9.6	16.9	23.2	...	8.9	...	58.7	27.5
11	BEVERAGES	1.8	2.8	.6	...	3.2	...	8.4	4.6
12	TOBACCO AND TOBACCO MANUFACTURES	7.8	14.1	22.6	...	5.7	...	50.3	22.9
2	CRUDE MATERIALS, INEDIBLE, EXCEPT FUELS	.3	51.2	1.3	...	22.8	...	75.6	50.0
21	HIDES,SKINS,AND FURSKINS, UNDRESSED	...	1.7	...	...	3.5	...	5.2	5.2
22	OIL-SEEDS, OIL NUTS, AND OIL KERNELS	.0	.7	...	...	.2	...	.9	.5
23	CRUDE RUBBER	...	.1	...	...	.0	...	.1	.1
24	WOOD, LUMBER, AND CORK	.1	21.0	.1	...	1.5	...	22.8	5.4
25	PULP AND WASTE PAPER	...	.6	...	...	.0	...	.6	.6
26	TEXTILE FIBRES	.0	.2	.0	...	2.7	...	2.9	2.7
27	CRUDE FERTILIZERS AND CRUDE MINERALS	.0	1.2	1.1	...	6.6	...	9.0	6.1
28	METALLIFEROUS ORES AND METAL SCRAP	.0	24.0	...	...	5.7	...	29.7	26.2
29	CRUDE ANIMAL AND VEGETABLE MATERIALS	.2	1.8	.0	...	2.5	...	4.5	3.2
3	MINERAL FUELS AND LUBRICANTS	2159.7	16528.8	.4	3311.2	62847.1	...	84847.1	82843.0
32	COAL,COKE AND BRIQUETTES	...	.0	...	...	.0	...	.0	.0
33	PETROLEUM AND PETROLEUM PRODUCTS	2153.1	15998.9	.4	3311.2	61741.0	...	83204.6	81289.8
34	GAS, NATURAL AND MANUFACTURED	6.6	529.9	.0	...	1106.0	...	1642.5	1633.2
35	ELECTRIC ENERGY	...	...	...	...	...	...	...	...
4	ANIMAL AND VEGETABLE OILS AND FATS	.0	2.1	.7	...	.1	...	2.9	.7
41	ANIMAL OILS AND FATS	.0	.2	...	...	.0	...	.2	.2
42	FIXED VEGETABLE OILS AND FATS	.0	1.2	.7	...	.1	...	2.0	.4
43	PROCESSED OILS AND FATS	...	.6	.0	...	.0	...	.7	.1

(Continued...)

Table 3-11: (Continued)

	COMMODITY GROUP	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	GCC REGION	
								GROSS	NET
		(MILLIONS OF U.S. DOLLARS)							
5	CHEMICALS	3.5	919.9	.9	71.1	49.2	...	1044.7	1018.3
51	CHEMICAL ELEMENTS AND COMPOUNDS	.1	24.0	.2	...	3.2	...	27.5	22.1
52	MINERAL TAR AND CRUDE CHEMICALS	...	774.3	...	...	3.7	...	778.0	775.9
53	DYEING, TANNING, AND COLOURING MATERIAL	1.3	11.3	.1	...	.7	...	13.5	3.1
54	MEDICINAL AND PHARMACEUTICAL PRODUCTS	...	.7	.0	...	.9	...	1.6	1.2
55	ESSENTIAL OILS AND PERFUME MATERIALS	1.0	5.1	.3	...	5.8	...	12.2	5.9
56	FERTILIZERS, MANUFACTURED	...	100.9	...	71.1	33.2	...	205.2	205.2
57	EXPLOSIVES AND PYROTECHNIC PRODUCTS	...	.0	.1	...	.0	...	.1	.1
58	PLASTIC MATERIALS, CELLULOSE AND RESINS	.5	2.3	.0	...	.9	...	3.7	2.3
59	CHEMICAL MATERIALS AND PRODUCTS, N.E.S.	.6	1.3	.2	...	.9	...	3.0	1.5
6	MANUFACTURED GOODS	212.4	292.7	12.8	114.3	116.1	...	767.0	424.6
61	LEATHER, LEATHER MANUFACTURES, FURSKINS	.0	.2	...	...	5.2	...	5.4	5.1
62	RUBBER MANUFACTURES, N.E.S.	.1	37.3	.5	...	3.1	...	40.9	31.3
63	WOOD AND CORK MANUFACTURES	.3	55.3	.1	...	4.0	...	59.7	44.0
64	PAPER, PAPERBOARD, MANUFACTURES THEREOF	1.0	12.9	.0	...	6.7	...	20.6	8.7
65	TEXTILE YARN, FABRICS, MADE-UP ARTICLES	2.1	50.4	3.1	...	17.5	...	73.2	27.2
66	NON-METALLIC MINERAL MANUFACTURES, N.E.S.	.9	47.3	5.3	...	2.8	...	56.3	11.7
67	IRON AND STEEL	18.1	34.9	2.0	114.3	10.0	...	179.2	36.0
68	NON-FERROUS METALS	137.2	4.0	.2	...	39.1	...	180.5	168.8
69	MANUFACTURES OF METAL, N.E.S.	52.8	50.4	1.0	...	27.7	...	132.0	91.0
7	MACHINERY AND TRANSPORT EQUIPMENT	76.9	381.5	57.4	...	291.4	...	807.2	597.3
71	MACHINERY, OTHER THAN ELECTRIC	63.2	69.5	10.0	...	78.1	...	220.8	165.0
72	ELECTRICAL MACHINERY AND APPLIANCES	6.3	100.9	5.8	...	42.5	...	155.5	84.1
73	TRANSPORT EQUIPMENT	7.3	211.2	41.6	...	170.7	...	430.9	347.4
8	MISCELLANEOUS MANUFACTURED ARTICLES	6.9	157.7	5.7	...	47.3	...	217.6	86.0
81	SANITARY, PLUMBING, HEAT, LIGHT FIXTURES	.0	5.4	.0	...	.8	...	6.2	2.3
82	FURNITURE	.4	24.4	.4	...	4.2	...	29.4	7.9
83	TRAVEL GOODS, HANDBAGS, SIMILAR ARTICLES	.0	2.7	...	...	.3	...	3.0	.6
84	CLOTHING	.4	61.6	.3	...	11.8	...	74.1	21.8
85	FOOTWEAR	.2	7.6	1.7	...	1.3	...	10.8	2.4
86	PROFESSIONAL AND SCIENTIFIC INSTRUMENTS	1.3	14.2	.2	...	4.6	...	20.3	10.7
89	MISCELLANEOUS MANUFACTURED ARTICLES	4.6	41.8	3.0	...	24.4	...	73.7	40.2
9	COMMODITIES AND TRANSACTIONS NOT CLASSIFIED	.3	5.1	...	...	.0	...	5.4	4.6
	TOTAL	2470.5	10415.9	120.9	3598.0	63419.2	...	80024.6	85209.4

TABLE 3-12: COMMODITY IMPORTS TO THE GCC REGION FROM THE REST OF THE WORLD: DETAILED CATEGORIES, 1979

	COMMODITY GROUP	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	GCC REGION GROSS	GCC REGION NET
						(MILLIONS OF U.S. DOLLARS)			
0	FOOD AND LIVE ANIMALS	155.1	703.1	154.4	149.3	2603.6	571.6	4337.1	4262.8
00	LIVE ANIMALS	18.4	86.7	2.1	22.1	230.5	16.6	376.4	373.8
01	MEAT AND MEAT PREPARATIONS	21.6	72.7	21.9	16.4	314.9	73.2	520.8	517.6
02	DAIRY PRODUCTS	13.9	67.6	25.8	18.6	289.3	60.8	475.2	472.1
03	FISH AND FISH PREPARATIONS	1.8	14.0	1.9	.5	45.9	9.2	73.3	69.9
04	CEREAL AND CEREAL PREPARTAIONS	29.5	113.6	42.3	33.5	794.5	145.7	1159.2	1147.1
05	FRUIT AND VEGETABLES	33.5	180.8	28.5	26.2	524.5	135.0	928.9	891.5
06	SUGAR, SUGAR PREPARATIONS AND HONEY	5.5	39.1	7.3	4.3	108.3	26.4	191.0	187.4
07	COFFEE, TEA, COCOA, AND SPICES	20.6	95.7	14.8	12.3	190.3	63.9	337.7	392.8
08	FEEDING STUFF FOR ANIMALS	2.5	10.4	2.8	1.7	44.3	6.9	68.6	65.8
09	MISCELLANEOUS FOOD PREPARATIONS	7.7	22.5	7.8	13.5	60.6	33.8	146.0	[illegible]
1	BEVERAGES AND TOBACCO	46.1	90.8	54.3	14.6	363.3	110.4	679.5	671..
11	BEVERAGES	14.6	20.6	14.9	3.8	185.6	32.1	271.7	265.3
12	TOBACCO AND TOBACCO MANUFACTURES	31.5	70.2	39.4	10.8	177.7	78.2	407.8	405.8
2	CRUDE MATERIALS, INEDIBLE, EXCEPT FUELS	17.2	107.7	14.7	43.1	380.1	80.8	643.6	620.3
21	HIDES, SKINS, AND FURSKINS, UNDRESSED	...	.0	.0	...	.1	.1	.2	.1
22	OIL-SEEDS, OIL NUTS, AND OIL KERNELS	.4	3.8	.1	...	19.7	.4	24.4	24.4
23	CRUDE RUBBER	.0	.1	...	...	1.3	.4	1.8	1.8
24	WOOD, LUMBER, AND CORK	10.8	58.1	12.3	5.5	239.4	41.1	367.2	362.1
25	PULP AND WASTE PAPER	.0	.0	...	...	.0	.3	.3	.3
26	TEXTILE FIBRES	.2	.7	.2	.4	6.2	.9	8.6	8.4
27	CRUDE FERTILIZERS AND CRUDE MINERALS	3.8	32.1	1.3	1.7	78.3	17.7	135.0	123.4
28	METALLIFEROUS ORES AND METAL SCRAP	.1	5.5	.0	35.4	8.2	15.6	64.8	59.0
29	CRUDE ANIMAL AND VEGETABLE MATERIALS	1.9	7.4	.8	.1	26.9	4.3	41.3	40.7
3	MINERAL FUELS AND LUBRICANTS	1276.7	36.1	83.8	9.4	155.8	638.2	2280.1	393.8
32	COAL, COKE AND BRIQUETTES	2.8	.3	...	...	1.9	1.5	6.6	6.6
33	PETROLEUM AND PETROLEUM PRODUCTS	1273.8	35.8	80.3	8.4	153.5	623.6	2175.3	385.3
34	GAS, NATURAL AND MANUFACTURED	.1	...	3.6	1.0	.4	13.2	18.2	1.9
35	ELECTRIC ENERGY	...	...	...	...	...	...	...	...
4	ANIMAL AND VEGETABLE OILS AND FATS	3.8	11.9	8.5	3.0	111.9	17.0	156.1	154.7
41	ANIMAL OILS AND FATS	.0	.1	.0	...	1.6	.1	1.8	1.7
42	FIXED VEGETABLE OILS AND FATS	3.8	10.9	8.4	2.9	101.6	16.6	144.2	143.0
43	PROCESSED OILS AND FATS	.0	1.0	.0	.0	8.6	.4	10.1	10.0

(Continued...)

TABLE 3-12 (Continued)

	COMMODITY GROUP	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	GCC REGION	
								GROSS	NET
					(MILLIONS OF U.S. DOLLARS)				
5	CHEMICALS	130.9	198.4	47.3	57.4	925.4	269.4	1629.0	1596.0
51	CHEMICAL ELEMENTS AND COMPOUNDS	75.3	52.1	.6	.5	83.0	26.3	238.6	233.2
52	MINERAL TAR AND CRUDE CHEMICALS	...	...	...	...	.9	1.0	1.9	1.9
53	DYEING, TANNING, AND COLOURING MATERIAL	10.2	10.8	12.9	6.9	125.1	34.7	200.7	189.1
54	MEDICINAL AND PHARMACEUTICAL PRODUCTS	7.4	35.3	9.5	6.7	199.1	37.2	295.1	294.6
55	ESSENTIAL OILS AND PERFUME MATERIALS	17.9	55.8	5.0	11.1	180.6	56.6	327.0	321.5
56	FERTILIZERS, MANUFACTURED	.6	.1	1.3	.0	8.0	4.2	14.2	13.7
57	EXPLOSIVES AND PYROTECHNIC PRODUCTS	.1	1.6	3.3	1.3	9.3	5.9	21.5	19.1
58	PLASTIC MATERIALS, CELLULOSE AND RESINS	4.8	20.0	3.0	6.3	194.4	54.1	282.6	279.6
59	CHEMICAL MATERIALS AND PRODUCTS,N.E.S.	14.7	22.7	11.7	24.5	124.2	49.6	247.5	243.5
6	MANUFACTURED GOODS	257.8	1296.8	187.7	237.5	6031.9	1520.6	10340.6	10032.5
61	LEATHER,LEATHER MANUFACTURES,FURSKINS	.4	2.2	.1	.2	8.6	1.0	12.4	12.3
62	RUBBER MANUFACTURES,N.E.S.	8.2	72.0	10.6	6.9	270.0	53.5	421.2	418.2
63	WOOD AND CORK MANUFACTURES	14.5	66.5	12.8	9.8	441.6	61.5	606.7	593.5
64	PAPER,PAPERBOARD,MANUFACTURES THEREOF	18.1	71.5	4.1	6.6	225.2	40.9	366.4	353.0
65	TEXTILE YARN, FABRICS, MADE-UP ARTICLES	49.8	326.3	46.9	45.2	1003.7	408.8	1880.8	1861.1
66	NON-METALLIC MINERAL MANUFACTURES,N.E.S.	40.4	249.1	51.2	27.1	1212.1	160.3	1740.3	1675.0
67	IRON AND STEEL	38.1	309.0	36.4	53.7	1765.3	451.7	2654.1	2523.1
68	NON-FERROUS METALS	9.6	34.4	2.3	4.8	123.9	43.2	218.1	199.5
69	MANUFACTURES OF METAL,N.E.S.	77.9	164.9	33.2	85.2	1781.6	299.8	2442.6	2395.1
7	MACHINERY AND TRANSPORT EQUIPMENT	430.7	1848.4	496.3	759.1	10843.1	2410.1	15987.7	15866.9
71	MACHINERY, OTHER THAN ELECTRIC	168.3	480.5	136.1	496.9	3386.0	1118.2	5786.1	5746.2
72	ELECTRICAL MACHINERY AND APPLIANCES	153.7	573.2	105.2	133.7	3468.5	755.8	5190.1	5162.5
73	TRANSPORT EQUIPMENT	108.7	794.7	255.0	128.5	3188.6	536.1	5011.6	4958.2
8	MISCELLANEOUS MANUFACTURED ARTICLES	155.4	853.5	189.5	151.0	2908.3	750.2	5087.8	4875.4
81	SANITARY,PLUMBING,HEAT,LIGHT FIXTURES	17.1	39.4	6.4	17.6	159.9	54.4	294.8	292.2
82	FURNITURE	23.3	107.3	23.5	32.5	536.0	88.7	811.3	796.2
83	TRAVEL GOODS,HANDBAGS, SIMILAR ARTICLES	3.0	18.5	2.6	2.0	74.6	23.2	123.9	122.9
84	CLOTHING	31.4	283.6	11.0	16.5	511.3	200.0	1053.8	1034.0
85	FOOTWEAR	9.0	52.0	6.7	6.1	97.0	33.4	204.1	202.0
86	PROFESSIONAL AND SCIENTIFIC INSTRUMENTS	27.3	142.9	19.9	22.4	584.1	186.6	983.2	972.5
89	MISCELLANEOUS MANUFACTURED ARTICLES	44.3	209.9	119.5	53.9	945.3	163.9	1536.8	1454.8
9	COMMODITIES AND TRANSACTIONS NOT CLASSIFIED	4.6	57.8	...	...	60.5	50.7	174.0	173.0
	TOTAL	2477.5	5203.8	1246.4	1424.4	24384.3	6419.1	41155.5	38845.9

TABLE 3-13: BALANCE OF PAYMENTS STATISTICS -- SAUDI ARABIA, 1973-1980

	1973	1974	1975	1976	1977	1978	1979	1980
	(MILLIONS OF U.S. DOLLARS)							
CURRENT ACCOUNT								
CREDITS								
MERCHANDISE EXPORTS	5858.	32664.	27295.	35631.	40350.	36993.	56521.	100714.
OIL SECTOR	5831.	32584.	27176.	35509.	40229.	36849.	56373.	100558.
OTHER GOODS, SERVICES AND INCOME	775.	2602.	3201.	4566.	6011.	6468.	7720.	8479.
INVESTMENT INCOME	205.	1219.	1859.	2912.	3988.	4301.	4916.	5387.
DEBITS								
MERCHANDISE IMPORTS	-1856.	-3569.	-6004.	-10385.	-14698.	-20021.	-23530.	-28237.
OTHER GOODS, SERVICES AND INCOME	-1370.	-7070.	-6498.	-11219.	-14351.	-18909.	-24253.	-33096.
INVESTMENT INCOME -- OIL SECTOR	-343.	-4896.	-1615.	-2206.	-2445.	-1162.	-2065.	-5720.
OTHER	-68.	-82.	-509.	-1074.	-1635.	-3350.	0.	0.
OTHER	-958.	-2093.	-4375.	-7939.	-10272.	-14397.	-22189.	-27376.
TOTAL: GOODS, SERVICES AND INCOME	3407.	24627.	17993.	18593.	17313.	4531.	16457.	47860.
PRIVATE UNREQUITED TRANSFERS	-392.	-518.	-555.	-988.	-1506.	-2845.	-3366.	-4063.
OFFICIAL UNREQUITED TRANSFERS	-497.	-1014.	-3128.	-3323.	-3901.	-3900.	-3503.	-3998.
TOTAL: CURRENT ACCOUNT	2518.	23095.	14311.	14282.	11906.	-2214.	9589.	39799.
CAPITAL ACCOUNT								
DIRECT INVESTMENT AND OTHER LONG-TERM CAPITAL	-913.	-8874.	-9138.	-11156.	-7504.	1779.	-3708.	-27558.
SHORT-TERM CAPITAL	-687.	-3831.	3895.	591.	-1706.	-11640.	-5647.	-8293.
NET ERRORS AND OMISSIONS	0.	0.	0.	0.	0.	0.	0.	0.
CHANGE IN RESERVES, INCL. COUNTERPART ITEMS	-918.	-10389.	-9068.	-3717.	-2697.	12074.	-234.	-3947.
TOTAL: CAPITAL ACCOUNT	-2518.	-23095.	-14311.	-14282.	-11906.	2214.	-9589.	-39799.

SOURCE: IMF, BALANCE OF PAYMENTS STATISTICS, VOLUME 32, YEARBOOK, PART 1, 1981.

TABLE 3-14: BALANCE OF PAYMENTS STATISTICS -- KUWAIT, 1975-1980

	1975	1976	1977	1978	1979	1980
			(MILLIONS OF U.S. DOLLARS)			
CURRENT ACCOUNT						
CREDITS						
MERCHANDISE EXPORTS	8486.	9614.	9530.	10235.	18113.	20724.
OIL SECTOR	7892.	8885.	8738.	9395.	17017.	19189.
OTHER GOODS, SERVICES AND INCOME	1768.	2230.	2629.	3660.	4929.	7370.
INVESTMENT INCOME	1282.	1631.	2007.	2963.	3746.	5993.
DEBITS						
MERCHANDISE IMPORTS	-2348.	-3192.	-4490.	-4326.	-4871.	-6889.
OTHER GOODS, SERVICES AND INCOME	-946.	-1166.	-1654.	-2150.	-2678.	-3727.
OTHER	-131.	-124.	-195.	-294.	-416.	-640.
TOTAL: GOODS, SERVICES AND INCOME	6960.	7486.	6015.	7419.	15492.	17478.
PRIVATE UNREQUITED TRANSFERS	-276.	-315.	-370.	-433.	-532.	-791.
OFFICIAL UNREQUITED TRANSFERS	-793.	-223.	-879.	-800.	-756.	-888.
TOTAL: CURRENT ACCOUNT	5891.	6948.	4766.	6186.	14204.	15799.
CAPITAL ACCOUNT						
DIRECT INVESTMENT AND OTHER LONG-TERM CAPITAL	-1937.	-4063.	-525.	-477.	-537.	-65.
SHORT-TERM CAPITAL	-93.	321.	-56.	-687.	65.	-933.
NET ERRORS AND OMISSIONS	0.	0.	691.	-2627.	-2610.	-2507.
CHANGE IN RESERVES, INCL. COUNTERPART ITEMS	-3861.	-3207.	-4875.	-2395.	-11122.	-12294.
TOTAL: CAPITAL ACCOUNT	-5891.	-6949.	-4766.	-6186.	-14204.	-15799.

SOURCE: IMF, BALANCE OF PAYMENTS STATISTICS, VOLUME 32, YEARBOOK, PART 1, 1981.

TABLE 3-15: NET FOREIGN ASSETS OF THE CENTRAL BANKS AND THE COMMERCIAL BANKS OF THE GCC REGION, SELECTED YEARS, 1960-1980

YEAR	BAHRAIN	KUWAIT	OMAN	QATAR	SAUDI ARABIA	UAE	GCC REGION
			(BILLIONS OF U.S. DOLLARS)				
1960	...	.35	...	...	.16	...	.51
1965	.05	.64	...	...	.76	...	1.44
1970	.12	1.11	...	.05	.96	...	2.24
1971	.15	1.42	...	.08	1.76	...	3.42
1972	.14	1.62	.21	.10	3.15	...	5.22
1973	.12	1.66	.14	.12	5.08	.38	7.49
1974	.24	2.81	.11	.13	22.24	1.38	26.96
1975	.36	3.15	.10	.33	39.20	2.41	45.54
1976	.41	3.13	.09	.43	52.25	3.74	60.05
1977	.42	4.37	.31	.51	61.40	.53	67.54
1978	.55	4.87	.22	.63	61.67	.58	68.51
1979	.62	5.19	.54	.71	64.84	.91	72.81
1980	1.18	6.77	.98	.92	94.38	2.71	106.96

SOURCE: IMF, INTERNATIONAL FINANCIAL STATISTICS YEARBOOK, 1982.

NOTE: THE SYMBOL ... INDICATES "NOT AVAILABLE."

TABLE 3-16: FOREIGN WORKERS IN THE GCC REGION, BY NATIONALITY, 1975

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Arab workers							
Egyptian	1,237	37,558	4,600	2,850	95,000	12,500	153,745
Yemeni (YAR)	1,121	2,757	100	1,250	280,400	4,500	290,128
Jordanian and Palestinian	614	47,653	1,600	6,000	175,000	14,500	245,367
Other	3,228	55,312	2,500	4,770	149,500	30,500	245,810
Total	6,200	143,280	8,800	14,870	699,900	62,000	935,050
Asian workers							
Pakistani	6,680	11,038	32,500	16,000	15,000	100,000	181,218
Indian	8,943	21,475	26,000	16,000	15,000	61,500	148,918
Other	981	1,103	200	2,000	8,000	2,000	14,284
Total	16,604	33,616	58,700	34,000	38,000	163,500	344,420
Other foreign workers							
European and American	4,442	2,028	2,800	846	15,000	5,000	30,116
Other nationalities	2,039	29,077	400	4,000	20,500	21,000	77,016
Total foreign workers	29,285	208,001	70,700	53,716	773,400	251,500	1,386,602

SOURCE: J. S. Birks and C. A. Sinclair, "International Migration in the Arab Region -- Rapid Growth, Changing Patterns and Broad Implications," Arab Planning Institute and International Labour Organization, Seminar on Population, Employment and Migration in the Arab Gulf States, Kuwait, December 1978.

PART II

THE RESOURCE BASE AND ITS UTILIZATION

CHAPTER 4

WATER RESOURCES

4-1. SIGNIFICANCE OF WATER AS A RESOURCE

Water appears plentiful, as it covers almost 80 percent of the surface of the earth, but only a small fraction of it is available for direct use by humans. Water is very important in agriculture for irrigation, in industry as a raw material and a coolant, and for direct consumption by humans. Civilizations have evolved and prospered only in areas where fresh water was available to cover their needs for domestic, agricultural, and manufacturing use. Industrialization and population growth have changed the significance and the uses of good quality water. The United States, for example, was using 370 billion gallons of water per day in 1970. Industry used about 57 percent of this total, irrigation 35 percent, and the general population the remaining 8 percent. Most of this water, about 86 percent, was fresh water from surface or underground sources. By 1980, water consumption in the United States had increased to about 860 billion gallons per day and had become a restriction on development in some arid areas, as for example parts of the southwestern U.S. It is evident that as industrialization and the standard of living of a population advance, the demand for water increases rapidly. Availability of good quality water can set limits to growth, even in the most developed nations.

As is well known, the GCC member countries have experienced a dramatic increase in their water demand in the last decade and the projection for the balance of the century is that the demand for water will increase even further (section 4-4). The increase in demand for good quality water is very significant for the GCC region as the countries which comprise it are situated in an arid area of the planet and have limited water supplies. Industrial development, agricultural growth, and the objectives of food self-sufficiency and advancement in the standard of living are tied to the availability of good quality water. Good quality water is scarce and the cost of its production is high. Consequently water has to be managed very carefully, using the best available technology, especially in view of the fact that a substantial part of the available water resources is of a fossil nature, and therefore non-renewable. Furthermore, a substantial proportion of the existing ground water resources is shared directly or indirectly by two or more GCC member countries. Since it is equally important to the development of each member, water has to be treated as a limiting common resource that may determine the extent of future growth in the agricultural, industrial, and urban sectors of the economies of the GCC members.

4-2. IMPORTANCE OF TREATING WATER AS A COMMON RESOURCE

Among the water resource types that are presented in the supply component of the water balances of section 4-4 of this chapter, ground water can be considered as the most significant shared resource since it is the least abundant.

From a geological point of view, the Arabian peninsula can be divided into two major parts, the Shield and the Shelf. The Shield is the outcrop of the crystalline basement and occupies Western Saudi Arabia and adjacent areas, from the Gulf of Aqaba to the Gulf of Aden (Figure 4-1). To the east of the Arabian Shield lies the Shelf, which is the subterranean part of the Shield covered by sedimentary strata.

The existence of extensive and major ground water aquifers within the East Arabian Basin is now a well established fact. The country members of the GCC share a common system of groundwater aquifers, with the exception of parts of Saudi Arabia which have underground water resources not directly shared by the other GCC countries, as well as the southeastern tip of the peninsula, east of the mountains that exist there. The lower Cretaceous outcrop horizon in Saudi Arabia has been considered as the boundary for this separation. (Reference 27). More specifically, the area of shared ground water resources in the Gulf states and the Arabian peninsula involves Eastern Saudi Arabia, Kuwait, Bahrain, Qatar, Oman, and the UAE. A hydrogeologic study of the region is not within the terms of reference of the present project. However, an awareness of the basic characteristics of the regional hydrogeology is essential in establishing the character and the shared nature of the water resources in the region, so that development strategies can take into account the limitations that they impose.

A considerable volume of data on the hydraulics, hydrochemistry, and geophysics of the area has been accumulated as the result of a number of independent studies (e.g., references 27, 28) and this has allowed the proposal of alternative regional hydrogeologic models. The models suggest the presence of three groups of aquifers, with some disagreement on their form and interrelations. First, there is a substantial system of deep aquifers with possibly stagnant water that has been identified in Saudi Arabia and proposed as being of a non-shared nature. (Reference 27). Furthermore, two more complex groups of dynamic and less deep shared aquifers have also been identified. The complex group of aquifers has been subdivided into two systems, A and B. (Reference 27). System A is the principal dynamic aquifer group. It consists of three main aquifers referred to as upper, middle and lower, with the upper and middle ones being essentially two strata of the same aquifer. This ground water system has been shown to be without major anomalies, and to have some recharge in its outcrop areas in the interior of Saudi Arabia, a groundwater flow towards the north and east, and an open discharge line at the sabkhahs. The middle aquifer (Umm Er-Radhuma) and the sabkhah discharge line have been suggested as very important features for the exploitation of this aquifer system. (Reference 27). It has been suggested too that while the sabkhahs are active they act as throttles, allowing only a certain volume of water to go past them. If for any reason the flow in the aquifer were to increase, the excess flow would be discharged onto the surface, at the sabkhah line, and would evaporate. According to this model, areas downstream from the sabkhah line cannot benefit by possible increased recharge of the aquifer above the sabkhah line. However, excessive pumping of the Umm Er-Radhuma aquifer above the sabkhah line can, according to the same model, cause hydraulic changes below the sabkhah line and even disturb the second system of fresh water aquifers (System B) that exists further east. System A aquifers are not fresh water aquifers; their salinity level varies from one area to another, and ranges from mildly to highly saline. Figure 4-2 gives a schematic presentation of aquifer system A. (Reference 27).

According to the same hydrogeologic model, the third group of aquifers (System B) consists primarily of discontinuous lens-type aquifers that contain good quality water (fresh water). The fresh water lenses float on top of the more saline water of the Umm Er-Radhuma aquifer of System A, and extend east of the sabkhah line along Saudi Arabia, Bahrain, Qatar, and the UAE. Intensive pumping from the Umm Er-Radhuma aquifer in Saudi Arabia may cause mechanical instability of the fresh water lenses, intrusion of saline water, and deterioration of the fresh water quality. Figure 4-3 gives a schematic presentation of a typical fresh water lens-type aquifer of System B as suggested by the FAO study. (Reference 27).

The hypothesis of a system of lens-type fresh water aquifers floating on the more saline waters of System A has not met with general acceptance. An alternative model has been proposed, according to which the good quality water aquifers east of the sabkhah line are members of a complex of dynamic aquifers that are connected laterally with the groundwater systems of the Saudi Arabian mainland and, like tongues of fresh water, flow from Saudi Arabia towards the Gulf. (Reference 3). On the basis of this model, the abstraction of water in the mainland of Saudi Arabia can also affect seriously the availability of good water to other Gulf states, such as Bahrain, again by lowering the level of the Umm Er-Radhuma aquifer which underlies the fresh water aquifers.

It is not within the terms of reference of this study to attempt to resolve the differences of opinions, or even to enter the relevant discussions. However, it is important to note that, whichever of the two models one accepts, a major part of the ground water resources of the Arabian Shelf is shared among two or more states, and as a result, groundwater abstraction in the mainland can affect the quality and/or the supply of water available to other states in the region. The formulation of a joint development plan, among the countries with shared underground water resources, is therefore essential, and the GCC can play a significant role in that respect. Estimates of the total underground water flow of the system of dynamic aquifers indicate a flow rate of about 1200 million cubic meters per year over a 640 kilometers front extending from northern Kuwait down to 24°N. (Reference 27).

In addition to the underground water there is some precipitation. The main characteristic of the rainfall in the Eastern Arabian Peninsula and the Gulf states is its great variability in time and space. The mean annual precipitation in this area is between 50 and 100 millimeters, with slightly higher precipitation in the Kuwait (150 mm) and Oman (200 mm) areas. (Reference 27). Total precipitation is less important for aquifer recharge than the high intensity, storm-type of rainfall. Possible management plans for storm water should also take into consideration their significance for aquifer recharge, and hence consider them as a shared resource, wherever applicable.

Water produced by desalination of sea water, or by advanced treatment of waste water and recycling, can be considered as a non-shared resource. However, desalinated water from brackish water aquifers should be considered as a shared resource if the aquifers are shared by two or more countries. Water introduced into the area by other means, such as water imported by oil tankers returning for loading, should also be considered as a non-shared resource, unless paid for by two or more member states. Ground water in the eastern section of Oman, northeast of the Omani Mountains, could also be considered as a non-shared resource.

Most of the water in the system of shared aquifers described above is saline, with regional variation in salinity. Depending on the overall level of dissolved solids, this water could either be used directly for agriculture or be used as feed water to desalination plants. Brackish water is easier to desalinate than sea water, which has, on the average, a much higher level of dissolved solids.

Two processes are currently in use on a large scale for water desalination in the GCC region: reverse osmosis and distillation. Reverse osmosis involves the passage of water through a membrane, against the natural osmotic pressure, and this accomplishes a separation of water and undesirable ions. The process thus produces a stream of fresh water and a stream of brine which contains the dissolved solids initially present in the sea or brackish water. The process relies on high pressure to achieve the desired separation. During the distillation process, steam is produced by heating the saline water. The steam is subsequently condensed, yielding pure water (distillate). The use of the multi-stage flash evaporation technique, during which sea water is heated and made to flow through a series of flash chambers maintained at successively decreasing pressure, has improved the efficiency of distillation as a sea water desalination process. Distillation of saline water requires considerable heat input, and is used primarily in association with large power plants. Reverse osmosis, a novel and complicated technology, can be operated on a stand-by basis and need not to be associated with another operation. The GCC countries produce the bulk of fresh water using the waste heat from large power plants and distillation technology, rather than by reverse osmosis.

4-3. STATEMENTS ON WATER RESOURCE DEVELOPMENT BY GCC MEMBER STATES

Statements on the development of water resources by the GCC member countries are presented below. They highlight the objectives and attitudes of the respective countries towards the development of their water resources.

BAHRAIN

Although the policy pursued by the State of Bahrain has been to provide a blended supply of distilled water and ground water to ensure a chemical quality of acceptable standards for domestic use, most areas still rely on ground water as the construction of desalination plants did not keep pace with the growth in demand.

Piesometric data indicate that the aquifer from which the rate of abstraction is greatest has lost one to two meters of head in the last 25 years. This head decline has been shown to be associated with salinity increase in the ground water. The quality of the ground water is likely to deteriorate rapidly if abstraction continues at the present rate.

Major industrial, urban, and commercial developments are expected to materialize before 1985 and to be of greater dimension than anticipated in 1975. Further strain on the water system of the state is expected by then.

New plans have been formed to meet the new demand, extending to the year 2000, mainly by introducing new desalination plants. It seems likely that no major development of the Khobar aquifer will occur. (Reference 1).

It is believed that development of the ground water resources in mainland Saudi Arabia may affect the ground water situation in Bahrain. (Reference 4).

KUWAIT

The following statements have been extracted from the 1981 Statistical Yearbook of the Ministry of Electricity and Water of Kuwait. "Kuwait has realized in an exceptionally short period of time the objective of becoming self sufficient in fresh water resources." Kuwait secures its fresh water from the following main sources:

- Distilled water from distillation plants associated with electrical power generation
- Natural underground water from the water fields at Rawdhatain and Umm Al-Eish

"Kuwait was careful to utilize the brackish water discovered in various parts of the country and to serve as a supplementary source to distilled water. Brackish water could be used for household, agriculture, street sprinkling and livestock watering in addition to blending with distilled water. To make use of the brackish water Kuwait conveys it to consumers through a separate pipe network parallel to the fresh water."

"The positive evolution of electricity and water production in meeting people's daily consumption and satisfying the requirements of industry and agricultural expansion in the country are facts and basic assumptions for the Ministry of Electricity and Water."

OMAN

"At the time of the announcement of the second five year plan (1981-1985), the Minister of State and Foreign Affairs explained that the plan aims firstly to extend government services and utilities to the more remote areas of the country. Secondly the plan aims to develop the country's indigenous water, agricultural and fishing resources and to improve national self-sufficiency. Of the $6.2 billion allocated in the five year plan 462 million was allocated to the Ministry of Electricity and Water."

"The Government carried several water surveys in various areas of the Sultanate during the past years. However, there is need for further surveys and continuous monitoring of water resources in order to determine the best means to develop the natural water sources and to rationalize the use of water."

"The second five-year plan targets and policies of the water resources sector can be summarized in the following:

To assign top priority to the development of natural water resources.

To recourse to desalination plants as a transitional solution in the case where consumption by-passes the growth in the supply of natural water, or in remote areas where no natural water resources are available.

To implement an expanded program of surveys, research and actual drilling in exploration for new natural water resources.

To implement an expanded program of constructing small recharge and flood-control dams, in order to reduce the quantity of water seeping to the ocean and to improve the water table.

To expand the program of Government assistance in the repair of the existing Falaj systems, canals and wells.

To take measures for promoting the rationalization of the use of water."

QATAR

The recent expansion of the agricultural sector experienced in Qatar and the rapidly growing municipality of Doha have placed a considerable strain on the existing ground water resources of the country and the government of Qatar, as early as 1960, started a systematic effort to study these ground water resources. In late 1971, the government, with outside technical assistance (FAO, UNDP), initiated further studies aimed at achieving a close integration of the limited ground water resources with agricultural production, taking also into consideration present and future possible usage of water for municipal and industrial purposes. The government has continued to study closely the water situation of Qatar, with the central objectives of harmonious water resource development, agricultural development, and urban and industrial development. (Reference 16).

SAUDI ARABIA

"Water development to support kingdom-wide efforts to supply every city, town and village with adequate quantities of potable water of acceptable health standards will continue unabated during the plan period" (1980-1985).

"The large potential for commercial agricultural development utilizing fossil water and other sources has been recently confirmed. The indications are that from proven water resources a century of irrigation can be sustained on about a quarter million hectares of land ... without infringing upon requirements of priority user sectors such as potable water supply, essential industry and traditional agriculture."

The overall water requirements by 1985 are estimated to be close to 2.5 billion cubic meters per year.

Projections for water demand and supplies show that the situation in the Kingdom is critical in many locations and that the rate of development of community and other water supplies is not sufficient to keep pace with the requirements of the growing population. The ultimate objectives to which the Third Development Plan (1980-1985) will substantially contribute as part of a longer term national plan for water development are as follows:

- To provide sufficient quantities of good quality water, in line with public health standards to meet urban and rural population needs.
- To secure water supplies to cope with industrial development and to increase agricultural expansion in the kingdom.
- To conserve and develop the present known water resources.
- To seek new water resources.

"The general strategy to achieve these objectives will be that of maximizing the use of available water supplies at the least cost without unnecessary rates of decrement of non-renewable fresh water sources."

UNITED ARAB EMIRATES

The government, through the Ministry of Agriculture and Fisheries and the Department of Agriculture of the Emirate of Abu Dhabi, has taken steps during 1979 and 1980 to ensure that attention is paid to the preservation of one key resource -- water.

Because of the rapid increase in the population and the expansion of agriculture and forestry there has been a damaging effect on the water table in many areas -- a drop in the level of the water table and an increase in salinity. There are certain mountain areas where millions of gallons of rainwater could be harnessed and used as they rush down the wadis towards the sea.

Within the framework of a national water survey, from which a Central Water Authority will soon emerge, three major steps have been taken to prepare the implementation of a national water usage and conservation strategy. One move has been to bring the drilling of wells under the control of the government, and approvals must now be given for each well. A second move has been the granting of construction contracts for two major dams in the Hajar Mountains in two major wadis. Construction is expected to be completed in late 1982. A third is an increase in production of desalinated water, which is associated with the expansion of the country's industrial projects and power supply. These plants will relieve the pressure on good quality aquifers, so that eventually they will be recharged naturally.

Significant progress has been achieved in recycling sewage and this now provides enough water to satisfy all the irrigation needs of the parks and gardens of Abu Dhabi. (Reference 23).

From the statements presented earlier, it is evident that water resources and their development have been given high priority in the development plans of all the GCC member states. The limits on the availability of good quality water, and the direct relation of this availability to the urban, industrial, and agricultural growth of each state, have been recognized, and steps are being taken to extend the limits by the development or expansion of supply.

4-4. WATER BALANCES

We present a series of tables containing quantitative information about water balances in the individual GCC member countries. The tables provide estimates of water supply and water demand in 1980 and projections to 1985. The data have been extracted from official documents furnished by the individual countries, and these are cited in the tables. Whenever possible, the values have been cross-checked. In cases for which 1985 projections were not available for all items listed, the 1985 value was estimated using the respective 1980 value and the average annual rate of change over the period 1975-80. Such projections are presented in parentheses. The balances for individual countries are provided in Tables 4-1 to 4-6. In addition, a water balance is presented for the GCC region as a whole, in Table 4-7. Wherever special constraints are applicable on the values reported in a water balance, these are stated in the note at the bottom of the relevant table.

Each balance comprises two parts, the water supply part and the water demand part. Water supply has been further divided into water supplied directly through abstraction from fresh or brackish water aquifers, water supplied from desalination plants, surface (renewable) water such as stream water, water recycled following treatment of waste water, and water introduced into the balance by other possible means, such as water brought into the region by oil tankers returning to load oil. The water demand part has been subdivided into urban demand (associated with major urban centers), industrial demand, demand by rural areas (including livestock watering needs), and demand for use in agriculture and irrigation.

Comments on the water balance tables are provided in the following section, country by country, and then for the GCC region as a whole.

4-5. COMMENTS ON WATER BALANCES

BAHRAIN

Bahrain has faced a serious water supply problem and a significant deterioration of the ground water quality during the last ten years. The state is implementing a large-scale program to produce an increased volume of desalinated water in order to meet the demand. Direct abstraction from ground water aquifers was estimated by adding the water abstracted for rural and agricultural use to the water abstracted by the Water Supply Directorate wells. The water abstracted for agricultural and rural use was estimated as being approximately three times the aquifer recharge rate, and equal to 55,654 million gallons per year. (References 4, 27). This value was assumed to remain unchanged in the 1985 projections, as suggested in the Bahrain Water Supply System Development Study by the Water Supply Directorate (1980). Abstraction for the public water supply in the future will depend heavily on the demand exerted, the availability of desalinated water, and the blending rates adopted.

Desalinated water reported for 1980 is the actual volume produced, while 1985 figures are the projected desalination plant capacities.

The objectives of the water supply development program are to control the rate of increase in water demand, improve the water supply systems, and reduce the ground water abstraction rate by substituting desalinated water for ground water and by reclaiming urban waste water. The rapid deterioration of the ground water quality imposes a sense of urgency on the achievement of these objectives.

KUWAIT

Kuwait has two, separate, public water supply systems, one for fresh and one for brackish water. Most of the fresh water is produced by desalination, as reflected in the figures reported. The reported 1980 desalinated water supply is actual volume produced, while the 1985 value is projected plant desalination capacity, including the industrial desalination plants of the Kuwait National Petroleum Company and the Kuwait Oil Company. (Reference 7). Both figures contain the brackish water that is blended with the distilled water.

Recent data on reclaimed waste water supply were not available. The value reported is a projected estimate for 1970 from a 1967 report of the Ministry of Public Works. It can be considered as a low estimate of the actual potential for reclaimed waste water.

Two sources suggest that fresh water is also brought into the Kuwait water balance by pipeline from Shatt Al-Arab for agricultural use. (References 10, 29). The value reported under "other" for both 1980 and 1985 must be considered merely as a rough estimate of the actual flow rate, since it originated from the 1967 report. More recent values were not available to us.

The indicated large, positive balance for 1985 will be lower in reality, as the actual desalinated water output will be less than the reported plant capacity.

OMAN

The Dhofar area of Oman is the only part of the Arabian Peninsula to benefit from the summer monsoons. This resource should be developed and managed for crop and livestock development. (Reference 29). Data on the quantity of surface (renewable) water were not available. The ground water resources in Oman are limited. High abstraction rates have created problems, especially in the Batinah coast, where salination of the ground water and the soil have been observed. (Reference 12). Fresh water abstraction rates for the whole country were not available. The value reported in the water balance under aquifer abstraction refers to water abstracted for the capital and Salalah areas as reported in 1981 by the Directorate of General Statistics. (Reference 11). Most likely it does not include water abstracted from private wells for agricultural or rural use in other parts of the country.

Desalination capacity has been reported for the capital area only. (Reference 11). The value reported in the water balance desalination section appears to be the actual volume of desalinated water produced in 1980, and not the plant capacity. It is within the objectives of the second five-year plan to increase the desalination capacity of the capital from 6 to 12 million gallons per day, as well as to add new capacity at Masirah Island and other remote points. Values of the planned capacities were not available. The 12 million gallon figure was taken as a low estimate of the desalination capacity by 1985, on the assumption that the new plant will be on stream by then.

Oman has available renewable surface water also. The estimate used in Table 4-3 is the value reported in the second five-year plan as the quantity of water that seeps into the ocean from the Northern Oman region. In the absence of more detailed data, this value has been used as an estimate of the resource in 1980, and assumed to hold also for 1985.

The urban-industrial data presented in the demand section of the water balance refer to actual water demand observed in the capital area, as reported by the General Statistics Directorate. (Reference 11). In the case of the combined rural-agricultural component of demand, the value reported in the second five-year plan for Northern Oman is used, and taken as a low estimate of the total demand of that sector.

QATAR

Fresh water demand in Qatar is concentrated in the main urban area of the capital Doha, which contains almost 96 percent of the country's population, and in the country's principal industrial centers. A serious deterioration of quality of the water abstracted from fresh water aquifers, especially in the Doha area, has indicated that Qatar also will need increasing quantities of desalinated water to meet the rising level of demand. The high cost of desalinated water suggests that measures are required to control water consumption. The projected positive balance for 1985 is higher than the actual one because of losses of water in the public water supply network (currently around 20 - 40 percent) and because desalinated water production is lower than the stated plant capacity. (Reference 16).

The augmentation of fresh water supply by incoming empty crude oil tankers has also been considered by the Ministry of Industry and Agriculture, but has been rejected, primarily for reasons relating to the security of supply and problems of water quality control.

Reclaimed waste water, for agricultural uses, is another water resource under development in Qatar. The value reported for 1985 is the projected waste water treatment capacity that will be available, provided that the upgrading and expansion of the existing collection and treatment facilities is completed. This projection is based on the recent Master Water Resources Development Plan.

SAUDI ARABIA

The third development plan of the Kingdom of Saudi Arabia provides detailed information on the available water resources and the strategy for their development. The presentation of regional water balances for Saudi Arabia, in Table 4-5A, is necessary because of the significant differences in available resources among the regions of the country. These differences are reflected in the regional water balances by the contribution of each water resource type to the overall balance.

Saudi Arabia, because of its geographical size, dominates the GCC water balance. As already mentioned in section 4-2, close coordination and collaboration among the other Gulf states and Saudi Arabia is required for the development of the ground water resources of the Arabian Shelf because of the shared nature of these resources.

UNITED ARAB EMIRATES

The United Arab Emirates have limited ground water supplies and some renewable surface water supplies. The objective of the UAE administration is to limit ground water abstraction to a level equal to the natural aquifer recharge. A value for that level, or for current pumping rates, was not available to us. Two major dams are under construction in the Hajar Mountains (Wadi Bih and Wadi Ham), as stated in the "Record of Achievement" published by the UAE Ministry of Information and Culture in 1982. Volumetric flow rate data for the water that will become available from the two dams were not available. The water is mainly destined for agricultural uses. Emphasis is placed on the production of desalinated water. Five desalination plans will form the main desalination capacity of the UAE. The Jebel Ali aluminum smelting plant has a potential of up to 40 million gallons of desalinated water per day, depending on the level of activity of the plant ("Record of Achievement," 1982). Four smaller desalination plants have been authorized also, one of which, at Umm Al-Naar, has a capacity of 6 million gallons per day. (Reference 24). The value reported for 1985 under desalination in the UAE water balances comprises the maximum Jebel Ali capacity and the Umm Al-Naar capacity. Capacity values for the other plants were not available.

Treated municipal waste water (treated sewage effluent) is used extensively in the UAE for park irrigation and similar uses. The value reported represents the facility at Mafraq of 14 million gallons per day sewage, and the expanded Dubai city plant, with a capacity for serving 100,000 people, assuming approximately 800 liters of water used per day per person, and 65 percent of this water being recycled.

The demand component of the water balance is indicated as equal to or less than the value derived on the supply side of the accounts. Detailed data on water demand for the United Arab Emirates were not available.

GCC TOTAL

The first important characteristic of the overall GCC water balance is that it appears to be strongly positive, indicating a combined water supply well in excess of the combined demand. However, as discussed earlier, the supply and demand of Saudi Arabia, owing to the geographical and population size of this country, dominate the overall water balance of the GCC region, and mask the water supply problems encountered by other GCC member states, such as Bahrain. These problems are illustrated best by the individual water balances of each country. The dominating effect of Saudi Arabia on the regional water balance supports the idea that the development of the water resources of the region should be seen from a regional development point of view. The substantial contribution (near 70 percent) of non-renewable ground water resources to the overall water balance further indicates the need for cooperation in the development of the resources.

Another significant characteristic of the regional water balance is the increased contribution of desalinated water to the overall supply. This contribution is expected to increase more than four-fold in the 1980-85 period, and there is much evidence to suggest that it will become even larger after 1985. The same trend can also be observed in the individual water balances of the member states. Increased dependence on expensive desalinated water necessitates that water resources be managed carefully, and suggests strongly that the present water cost structure should perhaps be reviewed. (See section 4-6, below.) The use of reclaimed waste water is expected to increase more than six-fold in the 1980-85 period. This development should be encouraged, since water is an expensive resource in the GCC region, and should be used with maximum efficiency within the existing technological limits.

Finally, the expected more-than-doubling of water demand in the 1980-85 period, and the intention to develop the agricultural sector of the GCC region, indicate that difficulties will be encountered in developing water distribution and monitoring systems, and that the best available technology should be used for agricultural irrigation so that water waste will be minimized.

Values reported in the GCC total water balance are necessarily based only on the information available to us during the preparation of this report. Consequently, they should be considered only as estimates, and in some cases rather crude ones. However, the availability of reliable data for Saudi Arabia, and the dominance of Saudi Arabia in the overall GCC water balance suggest that these estimates are sufficiently realistic to draw the conclusions that we have stated.

4-6. ASPECTS OF WATER MANAGEMENT

All GCC member states have experienced a rapid increase in fresh water demand during the last decade. Most of the water has been provided either free of charge or at a nominal cost, and often it is not metered. Desalinated water. produced at high cost, has been called upon, and will have to continue to cover the increasing demand, inasmuch as ground water is available in only limited quantities. Proper management of fresh water is therefore essential.

A dramatic increase in desalinated water production is projected for the 1980-85 period (Table 4-7). Production of desalinated water from sea water may result in negative ecological side effects, as a result of the concurrent production of large volumes of concentrated brine. The brine has higher density than normal sea water and has the tendency to settle towards the sea bottom, disturbing the ecological balance. Desalination brines could however be used as resources for recovery of certain minerals (salt, magnesium, etc.). The GCC member states are faced with the same problem that western nations were faced with at the beginning of their industrialization: the trade-off of an altered environmental quality for technological advancement. A new environmental equilibrium may come to be established in each region, depending on the level and type of industrialization, the cost associated with environmental protection, and the progress in environmental protection technology. Nevertheless, it should be realized that the protection of the environment is not a luxury but a necessity; we have come to realize that our natural environment must be viewed as a shared common resource.

One of the water resources that may warrant further attention is treated municipal waste water. This type of waste water, when free of toxic industrial input, is not difficult to reclaim, and could be used for irrigation purposes and aquifer recharge. The fact that in most of the GCC states, the bulk of urban water demand is associated with a few large urban centers makes this option even more attractive, inasmuch as large volumes of waste water are available at a small number of specific locations. Recycling treated waste permits the same water to be used again and again. Recycling of industrial waste water could be confined to industrial areas if such water contains difficult-to-remove or toxic pollutants, or if an industrial area is isolated from other demand areas. Such recycling achieves substantial savings in total water usage. The technology applicable in each case is different, depending on the type of industry and the products manufactured. Advanced technology can, in certain cases, reduce substantially the need for fresh process water. The GCC total water balance reflects a substantial increase in reclaimed waste water use in the 1980-85 period.

Kuwait has made extensive use of a double public water supply system, thus allowing direct use of available brackish water. Such a system may relieve some pressure on the fresh water supply system, but it will also increase the salinity of the municipal sewage effluent, thus possibly making treatment and recycling of treated sewage effluent more complicated. The use of a double water system should be examined carefully for each specific case of possible application.

The introduction of advanced agricultural irrigation systems will increase the efficiency of water use in agriculture, and will assist in reducing the rate of increase of water demand. Similar effects may also result from metering and appropriate pricing of fresh water supplied by public water supply networks, and from controlling the rate of abstraction from agricultural wells.

In conclusion, because of the significance of water as a limiting resource for industrial growth and for the improvement of living standards in the GCC region, proper management of the resource, the use of the best available technology, and close cooperation among the GCC members states appear essential to the achievement of the desired objectives.

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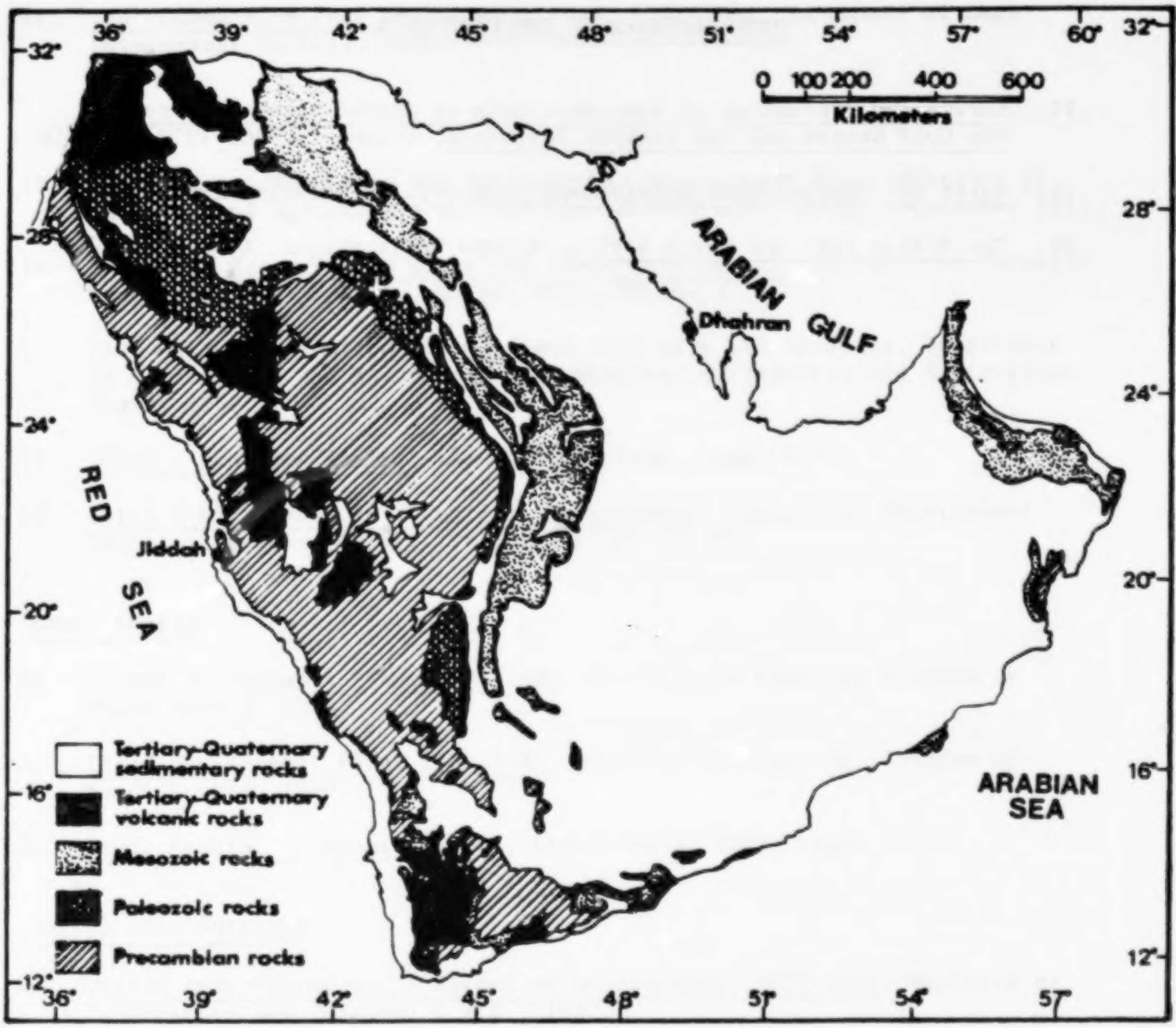
36°
39°
42°
45°
48°
51°
54°
57°
60°
32°
28°
24°
20°
16°
12°
0 100 200 400 600
Kilometers
ARABIAN GULF
Dhahran
RED SEA
Jiddah
ARABIAN SEA
Tertiary-Quaternary sedimentary rocks
Tertiary-Quaternary volcanic rocks
Mesozoic rocks
Paleozoic rocks
Precambian rocks

GEOLOGIC FRAMEWORK OF THE ARABIAN PENINSULA

FIGURE 4-1

SCHEMATIC HYDROGEOLOGICAL CROSS SECTION OF THE ARABIAN SEDIMENTARY BASIN

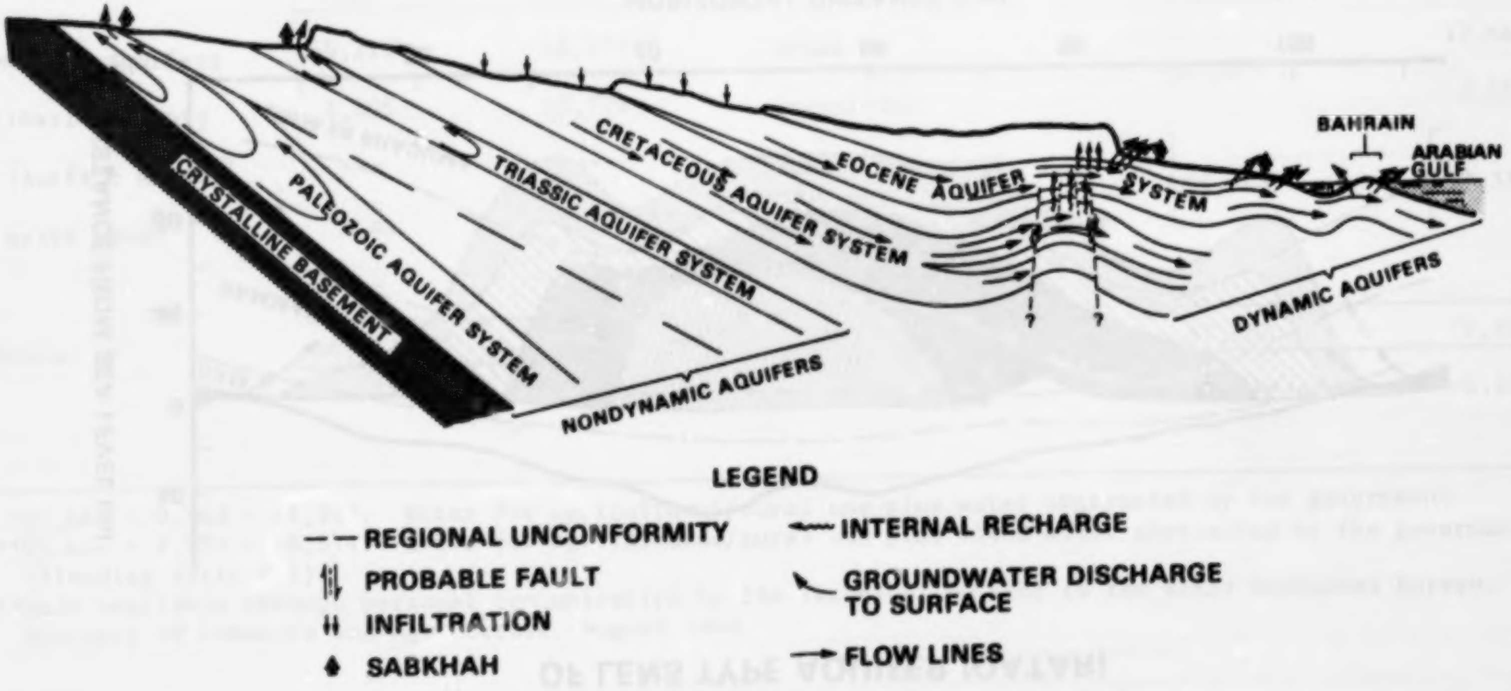
BAHRAIN
ARABIAN GULF
CRYSTALLINE BASEMENT
PALEOZOIC AQUIFER SYSTEM
TRIASSIC AQUIFER SYSTEM
CRETACEOUS AQUIFER SYSTEM
EOCENE AQUIFER SYSTEM
NONDYNAMIC AQUIFERS
DYNAMIC AQUIFERS
?
?
LEGEND
— — REGIONAL UNCONFORMITY
PROBABLE FAULT
INFILTRATION
SABKHAH
INTERNAL RECHARGE
GROUNDWATER DISCHARGE TO SURFACE
FLOW LINES

FIGURE 4-2

SCHEMATIC HYDROGEOLOGICAL SECTION
OF LENS TYPE AQUIFER (QATAR)

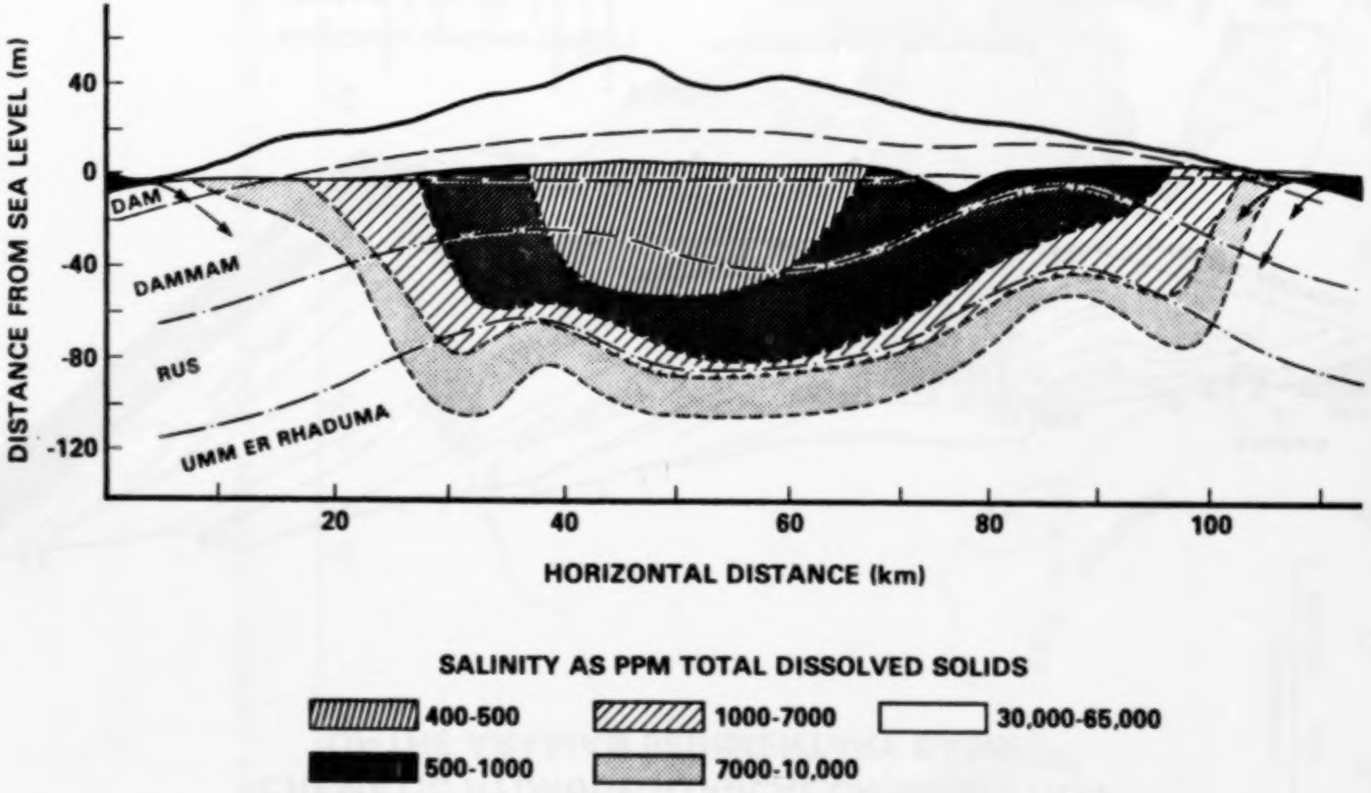
DISTANCE FROM SEA LEVEL (m)
40
0
-40
-80
-120
DAM
DAMMAM
RUS
UMM ER RHADUMA
20
40
60
80
100
HORIZONTAL DISTANCE (km)
SALINITY AS PPM TOTAL DISSOLVED SOLIDS
400-500
1000-7000
30,000-65,000
500-1000
7000-10,000

FIGURE 4-3

TABLE 4-1: WATER BALANCE: BAHRAIN

(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply			Demand		
	1980	1985		1980	1985
Abstraction from aquifers	65,217*	58,574**	Urban	11,954	12,566
From desalination plants	1,095	12,775	Industrial		2,555
Renewable (surface water)	...	...	Rural, livestock	55,654	57,333
Reclaimed waste water	n.a.	7,934***	Irrigation, agriculture		
Other	--	--			
Subtotal	66,312	79,283	Subtotal	67,608	72,454
			Balance	-1,296	+6,829

NOTES: *55,654 + 9,563 = 65,217. Water for agricultural/rural use plus water abstracted by the government.

**55,654 + 2,920 = 58,574. Water for agricultural/rural use plus blend water abstracted by the government. (Blending ratio 4:1).

***Made available through personal communication by the Technical Advisor to the Water Resources Bureau, Ministry of Commerce and Agriculture, August 1982.

TABLE 4-2: WATER BALANCE: KUWAIT

(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply			Demand		
	1980	1985		1980	1985
Abstraction from fresh aquifers	126*	(254)	Urban		
Abstraction from brakish aquifers	13,155	(16,170)	Industrial	48,991 fresh	73,528 fresh
From desalination plants	21,743	(86,029)**	Rural, livestock	9,750 brakish	12,322 brakish
Renewable (surface water)	--	--	Irrigation, agriculture		
Reclaimed waste water	8,043***	8,043***			
Other	25,550***	25,550***			
Subtotal	68,617	136,046	Subtotal	58,741	85,850
			Balance	+9,876	+50,196

NOTES: *Total fresh water produced including blend water.

**Total fresh water produced including contributions by Kuwait National Petroleum Company and Kuwait Oil Company.

***From 1967 report of Ministry of Public Works, Department of Agriculture. This water is piped in from Iraq from the Shatt Al-Arab. More recent data were not made available.

TABLE 4-3: WATER BALANCE: OMAN
(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply			Demand		
	1980	1985		1980	1985
Abstraction from aquifers	> 1,554	> 1,554****	Urban	2,075*	≥ 2,075
From desalination plants	1,447**	4,380****	Industrial		
Renewable (surface water)	35,218	35,218	Rural, livestock	> 40,815	> 40,815
Reclaimed waste water	n.a.	n.a.	Irrigation, agriculture		
Other	n.a.	n.a.			
Subtotal	> 38,219	> 41,152	Subtotal	> 42,890	> 42,890***
			Balance		

NOTES: *Capital area and Salalah.
**Capital area.
***Demand for 1985 is assumed to be higher than 1980.
****Lower estimate. Represents capacity planned to be installed during the second plan. The planned capacities of the smaller desalination plants at Masirah and other remote areas were not available.

TABLE 4-4: WATER BALANCE: QATAR
(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply			Demand		
	1980	1985		1980	1985
Abstraction from fresh aquifers	16,915*	16,610	Urban	10,896	16,266
Abstraction from brakish aquifers	717	(1,052)***	Industrial		
From desalination plants	10,570**	19,903**	Rural, livestock	16,610	16,610
Renewable (surface water)	...	...	Irrigation, agriculture		
Reclaimed waste water	348	2,631			
Other	--	--			
Subtotal	28,550	40,196	Subtotal	27,506	32,876
			Balance	+1,044	+7,320

NOTES: *Total abstracted from private agricultural wells and abstracted by the Water Department (16,610 + 305 = 16,915).

**Includes independent desalination plants operated by industry and solar distillation stations (9,935 + 635 = 10,570).

***Estimates using the same blending ratio as in 1980.

TABLE 4-5: WATER BALANCE: SAUDI ARABIA
(MILLIONS OF IMPERIAL GALLONS PER YEAR)

	Supply			Demand	
	1980	1985		1980	1985
Abstraction from aquifers	750,030	750,030	Urban	109,135	178,920
From desalination plants	13,696	131,527	Industrial		
Renewable (surface water)	248,923	248,923	Rural, livestock	5,870	6,088
Reclaimed waste water	--	30,436	Irrigation, agriculture	398,277	407,190
Other	--	--			
Subtotal	1,012,649	1,160,916	Subtotal	513,282	592,198
			Balance	+499,367	+568,718

TABLE 4-5A: SAUDI ARABIA: WATER BALANCE BY REGION*

(Millions of cubic meters per year)

Region	Supply	1980	1985	Demand	1980	1985
Central	Non-renewable	2,000	2,000	Urban & industrial	128	196
	Renewable	200	200	Rural & livestock	8	8
	Desalination	--	193	Irrigated agriculture	890	790
	Reclaimed from urban waste water	--	40	Subtotal	1,026	994
	Subtotal	2,200	2,433	Balance	+1,174	+1,439
Western	Non-renewable	--	--	Urban & industrial	219	343
	Renewable	225	225	Rural & livestock	7	7
	Desalination	52	237	Irrigated agriculture	125	200
	Reclaimed from urban waste water	--	85	Subtotal	351	550
	Subtotal	277	547	Balance	-74	-38
Eastern	Non-renewable	1,000	1,000	Urban & industrial	68	153
	Renewable	--	--	Rural & livestock	1	1
	Desalination	11	169	Irrigated agriculture	367	470
	Reclaimed from urban waste water	--	15	Subtotal	436	624
	Subtotal	1,011	1,184	Balance	+575	+560
Northern	Non-renewable	450	450	Urban & industrial	20	32
	Renewable	15	15	Rural & livestock	6	7
	Desalination	...	4	Irrigated agriculture	150	138
	Reclaim from urban waste water	--	--	Subtotal	176	177
	Subtotal	465	469	Balance	+289	+292
Southwestern	Non-renewable	--	--	Urban & industrial	67	99
	Renewable	705	705	Rural & livestock	5	5
	Desalination	...	2	Irrigated agriculture	300	275
	Reclaimed from urban waste water	--	--	Subtotal	372	379
	Subtotal	705	707	Balance	+333	+328

*Extracted from the Third Development Plan of Saudi Arabia.

TABLE 4-6: WATER BALANCE: UNITED ARAB EMIRATES
(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply	1980	1985	Demand	1980	1985
Abstraction from aquifers		n.a.	Urban		≤25,990
From desalination plants		16,790	Industrial		
Renewable (surface water)		n.a.	Rural, livestock		
Reclaimed waste water		9,200	Irrigation, agriculture		
Other		n.a.			
Subtotal	n.a.	≥25,990	Subtotal	n.a.	≤25,990
			Balance		

TABLE 4-7: GCC TOTAL WATER BALANCE
(MILLIONS OF IMPERIAL GALLONS PER YEAR)

Supply			Demand		
	1980	1985		1980	1985
Abstraction from aquifers	847,714	844,244	Urban	710,027	852,248
From desalination plants	48,551	271,404	Industrial		
Renewable (surface water)	284,141	284,141	Rural, livestock		
Reclaimed waste water	8,391	58,244	Irrigation, agriculture		
Other	25,550	25,550			
Subtotal	1,214,347	1,483,583	Subtotal	710,027	852,248
			Balance	+504,320	+631,335

CHAPTER 5
AGRICULTURE

5-1. INTRODUCTION

Agriculture is a crucial sector in the countries of the Gulf Cooperation Council, not because of its ability to generate high levels of domestic or foreign earnings, but because of its potentially limiting influence on balanced development. The countries of the GCC occupy a unique position in the global spectrum of stages of economic development. They are wealthy countries with some sectors being exceedingly modern and well developed while other sectors have experienced only limited changes. The notion of a "dual economy" employed in the development economics literature is particularly appropriate to the GCC member states. The principal development advantage that all GCC countries have is the flow of funds available from oil reserves. Although some member countries are relatively more affluent than others, all have considerable hydro-carbon based wealth which can be used to stimulate growth in other sectors.

Agriculture in the GCC states exhibits all of the characteristics of dualism. It can be partitioned into a highly mechanized commercial subsector and a traditional subsistence-type subsector. Thus agriculture presents within itself the same development problems as the total economy. This chapter examines the agricultural resources of the various Gulf states. The objective of the examination is to place agriculture in a development context for the regional economy. To this end the particular strengths and weaknesses of agriculture in each country are examined. Demand conditions for agricultural products are noted, as are supply capabilities. Existing forward and backward linkages are presented with a view to setting the context for further resource based processing. The aim of the chapter is to present an overview of the agricultural sector, particularly as it is affected by, and affects, other sectors of the individual country economies or of the GCC economy as a whole. Detailed analysis of individual commodities or agricultural projects is beyond the scope of this project.

Analysis of the resources available to agricultural planners within the various GCC countries suggests that there is no shortage of technical studies on the feasibility of cultivation of individual crops in particular areas, or of the benefits and costs associated with particular investment projects. The micro-data base is well developed and is continually expanding through the research efforts of international agencies (such as the FAO), the ministries of agriculture of the countries concerned, and private consultants. Where information is scarce is at the macro or sectoral level.

Linkages among agriculture and the other sectors of the economy are not well documented. Figure 5-1 provides an indication of these macro or sectoral linkages. It depicts the major links between agriculture and the local suppliers to and purchasers from the agricultural sector. The economic linkages to other primary sectors are strong. Fisheries, oil and gas, water and mineral sectors all have links to agriculture. The nature of the various linkages are discussed within the present chapter, as well as elsewhere in this report.

5-2. THE RESOURCE BASE

Fundamentally, the region occupied by the GCC states is not well suited to agriculture. Although agricultural production is a traditional economic activity of the population under natural circumstances, the climate and land severely restrict both the types and quantities of crops and livestock. Table 5-1 indicates the land base of the six countries in terms of total area and agricultural land of various types. Table 5-2 provides similar information in percentage terms. The crucial element in these tables is the relative scarcity of agricultural land in the region. Of the total land base of 247,519,000 hectares only 1,164,000 hectares or .47 percent is suitable for crops and 87,552,000 hectares or 35.37 percent is suitable for permanent pasture. The extreme scarcity of land suitable for cultivation places a very real limit on the quantity of crops that can be grown, even with massive infusions of such inputs as labour, machinery, chemicals, and water. Table 5-1 also indicates that Saudi Arabia dominates agricultural production in the region. This dominance arises from its relative size, but also because Saudi Arabia and Oman are the only two countries in the region that have areas with sufficient precipitation to allow agricultural production without irrigation. Those areas are limited in size but constitute a significant resource.

Irrigation is the key factor in developing increased agricultural production in the GCC region. As Table 5-1 indicates, although irrigated acreage is increasing in Saudi Arabia and Oman it has been relatively stable in the other countries over the past decade. The FAO estimates of irrigated land are necessarily somewhat crude, owing to the generally limited data available from the respective countries. However, even if irrigated land is expanding at a faster rate than is indicated in Table 5-1, the potential land base in Bahrain, Kuwait, and Qatar will soon be exhausted. Thus if the GCC seeks to expand cropland it will have to be in Saudi Arabia and Oman or, to a lesser extent, the United Arab Emirates.

Pasture figures tend to exaggerate the relative potential for livestock herds. Even for livestock species that are well adapted to the indigenous vegetation, such as camels, goats, and sheep, the animal density rates on native pasture are very low. With the exception of southern Oman, pasture conditions without irrigation in the region are poor. Only in the immediate vicinity of oases does natural pasture provide sufficient plant matter to sustain continuous grazing. Even then only a limited number of animals can be supported.

Despite the relative paucity of land resources and the harsh climate, a significant portion of the population has been engaged, historically, in agriculture within the region. Although this proportion is continually falling as the countries become more urbanized, agriculture is still the dominant source of employment in Saudi Arabia and Oman. Table 5-3 indicates the relative proportions of the population employed in agriculture (where the figures are available). In the four smaller countries, the proportion of the population in agriculture is small, reflecting the dominance of major urban centres. Note too that in addition to the slow decline in the share of population in the agricultural sector there is also a decline in the economically active group as a proportion of the total agricultural population. These figures are consistent with the movement of younger individuals to urban centres, leaving the rural areas with an aging population structure. Additional information on the sectoral distribution of labour is presented for three countries in Table 5-4.

Production capabilities of those engaged in agriculture are exceedingly divergent. At one end of the spectrum are those employed at the large turn-key livestock projects where the most modern technology is employed. At the other end are nomadic herdsmen whose production technology is hundreds of years old. The fundamental labour problems in agriculture are two: the first is how to reduce employment in the agricultural sector; the second is how to improve the skills of those remaining. The same impediments limit solutions to both problems. Those engaged in traditional agriculture have no skills other than traditional farming skills and limited opportunities to acquire new skills. Thus individuals lack the basic skills to participate in the expanding sectors of the economy. At the same time, they also lack the skills required to adapt to high technology agriculture. (Reference 22, p.37).

Structural problems also inhibit the expansion of production. For traditional farmers, average farm holdings are far less than the minimum size necessary to operate a viable modern family farm. Similarly, adoption of modern technology is limited by scarcity of machinery, spare parts, and mechanics to service the equipment. The various countries are attempting to alleviate these problems by subsidizing domestic production, providing concessionary financing for inputs, and expanding research and extension programs. All these programs are long-term solutions that have limited short-run impacts if farmers are unwilling or unable to adjust production techniques, and the manpower to implement the programs is in scarce supply.

Various FAO studies and domestic reports note the critical shortage of skilled personnel working in agriculture. These shortages occur in such diverse areas as program implementation and administration within the ministries themselves, research and extension activities in the various stations, and the supply of skilled technicians on the farm. Low educational levels and skills of the local population make the successful adoption of advanced agricultural production techniques problematic. However, if output is to be expanded, adoption of highly sophisticated irrigation practices and livestock management methods will be necessary, particularly in the adverse climatic conditions such as are experienced in the Arabian Peninsula. Thus, the crucial requirement for the successful introduction of the advanced agricultural technology that is essential if the GCC states are to increase output is the availability of skilled manpower necessary to operate and maintain the equipment.

5-3. THE EXISTING PRODUCTION SITUATION

In all six countries of the Gulf Cooperative Council there have been major expenditures to stimulate agricultural production. These efforts have been targeted at expanding traditional crops and cultivation practices and introducing new crops and technologies. Consequently, output has increased significantly in all countries. For certain crops, production meets domestic needs for at least part of the year, and in some instances there are exportable surpluses. However, despite the significant increase in production, demand has increased at a far greater rate, leading in many instances to growing gaps between domestic supply and demand. Table 5-5 indicates the value of domestic agricultural production (including fisheries) in the various GCC countries over the period 1970-1981. Over this period, the nominal value of output rose to levels ranging from 3.3 to 40.7 times the 1970 base values. The nominal value of output for the region as a whole increased 7.6 times, from 291.1 million to 2,210.9 million U.S. dollars.

Information on volumes and values of production by particular crop or livestock type is not readily available, particularly in a consistent form. However, Tables 5-6 through 5-9 provide rough indicators of the types and relative importance of various crops and domestic animals. The tables indicate that there has been a considerable increase in the production of fruits and vegetables, particularly tender crops such as tomatoes. Tree fruit production in the region is primarily composed of dates and lemons, and the data suggest that both products are experiencing increases in production. Livestock numbers indicate a significant availability of domestic meat and animal products. The livestock table does not indicate the major source of meat, which is confinement poultry production. Saudi Arabia alone has the capacity to produce over ten million birds per annum (as reported by the Saudi Arabian Ministry of Industry and Commerce). From the tables it is apparent that Saudi Arabia dominates the region's production of agricultural commodities in volume terms. This is hardly surprising, given the great diversity in size of the countries in terms of land base and population engaged in agriculture.

Yield figures, where available, suggest that output per unit of land is roughly comparable for all countries. This can be attributed to the need for water to sustain agricultural production. Where adequate water supplies are available, yields are roughly the same. Increases in output in the future will be limited by two factors, water availability and land availability. With respect to these two constraints, Saudi Arabia and Oman have a distinct advantage. They are the two largest countries with considerable quantities of arable land that can be readily improved where now cultivated, or brought into production if now uncropped. In addition, they both possess regions where water is less of a constraint than in other parts of the peninsula. The south west coast of Saudi Arabia and southern Oman are areas where supplemental irrigation is sufficient to produce a crop. In many instances, the required irrigation water can be obtained by impounding storm run-off. Other areas of the peninsula require full irrigation if a crop is to be produced. They also rely on non-renewable ground water or upon very expensive desalinated water, both of which have high opportunity costs. As a result, the true social cost of production is high.

Fruits, vegetables, and some row crops can be grown under full irrigation regimes in quantities large enough to meet a significant share of domestic requirements. This is particularly viable in controlled environment green houses. For cereals, oil seeds, and coarse grains the potential to do so is much lower. These crops have far lower value per hectare, so that water has to be provided at a very low price in order to make the crops profitable. Where the water has a high opportunity cost, its allocation to cereals results in a major waste. In areas where there are soil moisture reserves from precipitation, or surface water is available, irrigation for cereals can be a viable option. Such areas are to be found only in Saudi Arabia and Oman. As noted frequently above, water availability is crucial for agricultural production in the GCC states. Irrigation water and livestock water are the obvious uses. However, in the hottest part of the year, water is also required to cool plants and animals. Although the water for cooling purposes need not be of good quality, in general there are limits to the quality of water that can be used in agriculture. As discussed in Chapter 4, salinity levels in many of the aquifers of the region make them unsuitable for agricultural use without treatment or blending with less saline water. This, however, increases the cost of the water. Once the water is of an acceptable quality for irrigation, problems can still arise.

Over time, with continuous irrigation, salts can build up in the soil leading to decreased fertility, lower yields, and ultimately zero production. For the most part, this problem can be controlled by appropriate choice of irrigation system and careful management. It would seem, however, given the severe shortage of highly skilled agricultural manpower in the GCC economies, that there is considerable potential for irrigation projects to go wrong. Similarly, the quantity of water necessary for production is highly dependent on the particular technology adopted and the sophistication of the farm management. Drip systems use far less water than traditional flood systems, or even centre pivot systems. They do, however, require higher levels of maintenance and monitoring. Similarly, for flood irrigation more frequent applications can reduce the total quantity of water that must be applied, but in order to do so fields must be levelled and care must be taken in controlling salt build-ups.

5-4. EXPANSION OF THE AGRICULTURAL SECTOR

For the various countries of the GCC, expansion of agricultural production is an important government priority. Those countries which have development plans specify agriculture as one of the most important sectors of the economy to be stimulated through government intervention. For example, the Third Development Plan of Saudi Arabia states its objective to be

> "Directing a major proportion of the Kingdom's capital and manpower to the producing sectors, such as agriculture, industry and mining to ensure diversification of the economic base." (Reference 23, p.17).

The agriculture section of the plan consists of 26 pages outlining specific responsibilities and strategies for increasing productivity in agriculture and achieving a greater degree of self-sufficiency.

Similarly the Second Development Plan of Oman states as long-term development goals:

1. to develop new sources of national income to augment and to eventually replace oil revenues,

2. to increase the ratio of national investments directed to income generating projects, particularly in manufacturing, mining and fisheries. (Reference 24, p.30).

Short term goals articulated on pages 32-34 of the Omani plan emphasize agricultural development through the provision of inputs, extension and marketing services, and the development of irrigation projects.

Once again, emphasis is placed on the need to enhance agricultural production. Other GCC countries express similar concerns, as is evidenced by the resources that are dedicated to agricultural production. A number of reasons can be identified to explain this concern with stimulating a sector in which the various countries would seem to have a comparative disadvantage in terms of production potential.

The most viable rationale for the expansion is a concern with food security. The individual governments feel that relying virtually completely on imported food products is a dangerous option. There is some fear of an embargo by food exporting countries, and also a recognition of the difficulty of keeping supply routes open in the rea if war breaks out as a result of any of the volatile situations in the region. Consequently, plans to build up a source of domestic supply to reduce this dependency have been put in place.

A second reason for fostering agriculture can be explained by the social structure of the various countries. Agriculture contributes a small and declining share to gross national product, and varying proportions of the countries' citizens are either directly or indirectly employed in agriculture. As noted previously, these people often have limited skills and cannot be readily integrated into the growing high technology portion of the economy. Therefore, providing funds for agriculture may make sense as a short-run mechanism for distributing income to such people. Investments and subsidies to agriculture can be viewed, from this perspective, as transfer payment mechanisms. Since only nationals can own land, the transfers increase the welfare of citizens but not foreigners. In Bahrain, Kuwait, Qatar, and the United Arab Emirates, the proportion of the local population in agriculture is small enough to limit the utility of such transfer mechanisms. However, in Saudi Arabia and Oman, the large agricultural populations can be supported by such payments.

The problem that the GCC countries face of a growing gap between domestic supply and demand, despite rapidly increasing levels of output, can be attributed to the rapid influx of workers from other countries. To undertake the rapid development of the various economies, large numbers of offshore workers have had to be imported. As indicated in Table 2-2 of Chapter 2, available data suggests that the foreign proportion of the population in Bahrain, Kuwait, Qatar, and the United Arab Emirates varies from 32 to 69.5 percent of the total. Saudi Arabia has a lower proportion, while figures for Oman are not available. If the number of foreign workers could be reduced, the demand for food would be reduced accordingly: for example, reducing the number of foreigners by 50 percent would have an immense impact on aggregate food demands in the various countries of the GCC.

With the general rise in per capita income, adjustments in production are required to satisfy growing demand for fruits and vegetables, meats, and other superior goods in people's diets. Government incentives of various types are being employed to bring about these adjustments. Thus, the need to change the structure of agriculture provides another reason for government intervention.

5-5. GOVERNMENT ACTIVITIES IN THE AGRICULTURAL SECTOR

The governments of the various countries influence the agricultural sector in a wide variety of ways. Several broad classes of government programs may be identified in order to provide some order to the discussion which follows. These program classes are administration, research, extension, land development, provision of inputs, direct investment, and market facilitation. Each of these broad classes includes a number of specific types of programs. The particular combination of programs, and the relative importance of each broad class, may vary from country to country.

Administration is the simplest class to describe. Activities under this heading include the following: (a) integration of the various activities within the agricultural ministry to ensure that consistent objectives are pursued; (b) development and maintenance of a statistical data base to evaluate existing programs and needs for new programs; (c) coordination of the ministry of agriculture with the other national ministries; and (d) liaison among the individual ministries of agriculture of the various GCC countries. Other activities under the heading of administration are functional by nature and their purpose is self-evident.

The research function is particularly important if the indigenous resources of the countries, in terms of plant and animal species, are to be utilized more effectively. Research to improve yields of native forages for use as livestock feed and efforts to increase the productivity of native livestock herds would reduce the need to import foreign crop varieties and livestock, and the technology that is required to maintain them. In a similar vein, research to adapt foreign crops and livestock to the high heat and high salinity conditions which prevail throughout the largest part of the Arabian Peninsula is an important function. Research in crop production and animal breeding is important, but research in farm management is vital if the biological research is to be successfully implemented. New techniques, new crops, and new livestock species would have to be introduced into an existing farm structure. To do so successfully would require considerable knowledge of the existing objectives and methods of farmers and the development and implementation of techniques to incorporate the new with the old.

The line between research in farm management and extension activities is not clear. Extension activities take the results of research and convey them to the farmers in a form which they can make use of. Consequently, extension workers must understand both the farmer and the researcher. In the absence of an effective extension activity, successful adoption of new methods will be slow. If the extension agents can convince the farmer that the benefits from trying something new exceed the costs, the traditional agriculture sector will be able to progress rapidly. If, as is the case for the bulk of the traditional sector in the GCC, skills (including literacy) are low, the role of the individual extension worker will be critical in translating scientific research into readily understood techniques that can be adopted and applied by the farmer.

Land development activities include land reclamation, where infertile or semi-fertile land is improved by adding topsoil or organic matter. They also include land maintenance programs, such as planting of shelterbelts to prevent wind erosion and, of course, the provision of irrigation facilities such as community wells, dams, falaj, and major distribution systems. Where arable land is such a small proportion of the total land base, activities to enhance the supply of such land are vital. Physical problems arising from the development of agricultural water systems have been discussed in Chapter 4. Related economic matters are now considered.

The provision of inputs, such as pump sets, tractors or tractor services, fertilizer, improved seed and pesticides, is intended to stimulate the level of agricultural production. Currently, all of the GCC countries heavily subsidize such inputs to farmers. While subsidies of this kind have an important role in motivating the adoption of new inputs and technologies, it can be argued that they can lead to an inefficient allocation of resources if they are maintained in the long run. Rational farmers will adjust their production technology to make use of the inputs, according to their relative value in production and their cost. That is to say, farmers will equate marginal benefits with marginal costs. If an input is highly subsidized, it will be used to a greater extent than if the full cost had to be borne by the farmer. Thus, although output will be increased, it will be produced in an inefficient manner; farmers will utilize more of the input than is desirable. Subsidization of inputs is particularly important in the case of water. Too low a price for water encourages excessive use, reducing the supply available for other uses now, and for all uses in the future. Such subsidies would also explain the relatively great waste of water in irrigation projects since, from the farmer's point of view, water has a low cost. Provision of physical inputs to farmers who lack the skills to employ them properly also leads to waste. In particular, for durable inputs, such as tractors or pump sets, a supply of spare parts and the availability of trained service personnel are vital if the machines are to be used for any extent of time.

Direct investment by the government in agricultural production is also common in the GCC. This investment takes the form of partnerships between the government and private individuals or sole ownership by the government. It is useful for large-scale production units, particularly those introducing a new technology, crop, or type of livestock. Evidence from developed countries suggests that well managed, large production units exhibit the lowest unit costs of production. Such production units are typically capital-intensive and require large initial investments in specialized buildings and machinery. They also require highly skilled labour and management. The government, with its large resource base and its ability to spread risk, is often more willing to undertake such investments.

Market facilitation refers to the need to establish, enhance, or stabilize marketing channels. This form of intervention is particularly important for non-traditional crops where no markets exist. For the producer, knowledge that a crop or animal can be readily sold provides a major incentive to undertake or expand its production. Conversely, unsold production provides a strong signal to reduce output. Given the various other incentives to expand output, this marketing function is important. In several of the GCC nations seasonal surpluses are beginning to occur in tomato production. One might think that these typically localized surpluses, and other excess produce, could be marketed in a nearby country. As another example, new varieties of sorghum produced in the Wadi Jizan area of Saudi Arabia were not well accepted initially in local markets. (Reference 25). Market channels need to be opened to accommodate these situations, which have the potential to become more common as production increases in the region.

The preceding discussion has attempted to outline basic functions associated with individual ministries of agriculture. The primary issues or problems associated with each of the functions were introduced. Resolution of any of these issues will require a comprehensive set of programs which could easily entail an entire separate report. Since, in general, the issues and solutions are common to all the countries of the region, there would seem to exist considerable potential for cooperation within the GCC framework.

Table 5-10 indicates the historical levels of expenditure on development efforts in total, and on agricultural projects. It indicates that absolute expenditures on agricultural development increased in all countries over the 1970-1980 period. However, the relative share of development funds going to agriculture declined for all countries except Oman from 1975-1980, as compared to 1970-1975. This relative decline was most marked in Saudi Arabia. Over the 1970-80 period as a whole, the United Arab Emirates allocated the greatest relative share of development funds to agriculture.

5-6. COOPERATION IN AGRICULTURE

The existing level of cooperation in agriculture among the member states of the GCC is already quite high. Cooperation occurs on both a formal and an informal basis. At a formal level, there are projects that are jointly sponsored by the six countries, and others that involve the GCC states in cooperation with other Arab countries. At an informal level, the various ministries of agriculture are in contact to facilitate communication and exchange information. These informal contacts provide a potential medium for cooperation, ongoing coordination, and the development of joint activities. Similarly, special topics are discussed at conferences called for particular purposes. An example is the conference on food security and the food industry, held in Dubai in April of 1981.

Such organizations as the Arab Organization for Agricultural Development (AOAD) and the Council of Arab Economic Unity provide a general forum at the formal level. The AOAD conference on the Arab food reserve stock, which took place in Khartoum in 1980, suggested, for example, that the various Arab countries should hold a three-month reserve stock for security purposes. There are also specialized organizations, such as the Arab Centre of Studies on Arid Zones and Dry Lands which undertakes research on cultivation methods and crops. Similarly, the Arab Company for the Development of Animal Wealth provides funds for livestock development projects.

5-7. AGRICULTURAL PROCESSING

Processing opportunities for traditional agricultural products are fairly limited. The bulk of domestic production serves local needs and is often produced, processed, and consumed within a local market area. At this level, given the general lack of statistical information in the region, there is a considerable amount of uncounted activity. Data gathering procedures do not operate well at this low a level, particularly if the exchange process has no records. Traditional cash crops, such as dates and citrus fruit, require little in the way of processing prior to sale, either domestically or on the export market. Thus, agricultural processing is based primarily on expanded production of vegetables, livestock, and other non-traditional crops, or on the processing of imported raw materials, such as cereals and semi-finished products. Two types of processing structures can therefore be distinguished. The first involves a forward linkage from domestic production, and depends for its growth on the expansion of local agricultural output, either crops or livestock. The second is oriented toward transforming raw materials purchased abroad into final products.

The agricultural processing industry has several general characteristics that would appear to make it an unlikely sector for major growth within the region. In many cases, primary agricultural inputs to the industry are highly perishable. This eliminates the possibility of importing the raw material for local processing. For these types of processing facilities, such as meat packing and vegetable canning, any plants would have to rely on local supplies. In order to produce at prices competitive with processors in other areas of the world, the local industry would need heavy subsidies or low raw product prices. If, however, raw product prices are low to the farmer, so that the costs of production exceed the returns, the output will not be produced and the industry will be unable to operate. Thus, the implication is that, unless farmers can profitably produce the product at a low price, the processing industry will require subsidization or tariff barriers to inhibit foreign competition.

A second consideration is that most processing activities tend to be weight-reducing: the product loses weight during processing. Thus, waste is produced and discarded. This typically leads to processing plants locating close to the primary sources of raw agricultural product in order to take full advantage of reduced shipping costs. For the GCC states, processing plants that rely on imported raw materials (such as oil seed crushing plants) will be high-cost producers unless a relatively high value can be assigned to their by-products.

Otherwise, all of the large shipping bills associated with transporting the raw material will have to be assigned to the cost of producing the desired products.

Ultimately, the factor that most limits expansion of agricultural processing is the high cost of water in the region. Traditional agricultural processing plants use high volumes of water in virtually every stage of processing. Where the costs of water are high, processing of food products is a high-cost activity.

All of these influences place severe limitations on the growth potential of the food processing sector, particularly as an export-oriented industry. Opportunities for expansion of the sector will arise primarily through import substitution. In this vein, Oman has recently completed a feed mill in Muscat to formulate feeds for livestock. This will reduce the need to import such feeds. To the extent that local agricultural production can be increased and made available, a small but viable processing sector may develop. This is most likely in the poultry processing and vegetable processing sectors. Recent advances in recycling technology have reduced the water requirements for food processing plants. Using advanced technology, a net surplus of water can be produced. (Reference 26).
Of course, the costs of this technology are high, but such plants may appear viable when account is taken of the price of importing the processed product. Similarly, industries based on imported raw materials may be viable operations within the region if their waste products are not excessive.

With the great increase in population in the region, considerable opportunity exists for the beverage industry. Since the production process consists of adding water to a concentrate prior to packaging, the transport costs of the raw materials are low. Furthermore, the final product sales price is relatively high and will more than cover the true value of the water.

To the extent that the region's population reaches a large enough size that processing plants can take advantage of economies of scale, there is opportunity for increased activity. However, the particular type of operation must be chosen carefully if costs are to be kept under control.

5-8. INPUT SUPPLY INDUSTRIES

Planned expansion of the agricultural sector will create limited opportunities for growth of the agricultural input supply sector. In addition, the region would seem to have a comparative advantage in the production of certain agricultural inputs at a global level, in particular fertilizers. Table 5-11 indicates the existing capacity of fertilizer plants in the GCC. Mechanization of the agricultural sector creates the opportunity for specialized machinery fabricators, particularly for implements. Harrows, cultivators, and wagons could all be produced locally. Given the limited potential for growth in the production of crops it is unlikely that large tractors or combines could be economically assembled, let alone produced, especially with the GCC's severe shortage of skilled labour.

Fertilizer production is, of course, a logical outgrowth of the petroleum sector, although once again water requirements are high. Over time it may be possible to expand further into chemical production so that herbicides and insecticides could be produced. Such industries would have to be export-oriented since local demands will never be sufficient to exhaust the output of even a single herbicide or insecticide plant.

Expansion of fisheries, as discussed in Chapter 6, will provide a large volume of by-catch. Approximately 8,790 tonnes of by-catch were available in the region in 1979. The growing production of broilers and eggs in the region provides a major opportunity for the utilization of this by-catch. Fish-meal can be used as a protein supplement in livestock feed. Expansion of existing feed milling facilities to produce feed using an indigenous product would reduce import costs and provide stimulus to local fisheries.

Existing Food Processing Capabilities

We turn now to a brief consideration of the current status of the food processing industries. The aim is merely to provide some rough indication of the nature and extent of existing capability. Data on this subject are particularly difficult to come by and to organize within a consistent framework. Consequently, the available material is presented on a country by country basis.

Bahrain possesses some food processing capacity but this would seem to be designed solely for domestic production and to rely primarily on imported raw materials. Data for Kuwait are available for 1977, in which year Kuwaiti authorities counted 346 bakeries, 16 confectionary producers, 14 producers of dairy products, 7 animal feed producers, and 4 bottling operations. (Reference 27). Not surprisingly, bakeries dominate the sector in terms of numbers as they produce a highly perishable product which requires limited investment in capital or technology. Oman has developed fruit packing plants in Batinah and Salalah to take advantage of local production. In addition, there are new date storage facilities in Muscat. The country also has dairy facilities capable of producing .72 million litres of yogurt and 1.5 million litres of milk products. Flour milling capacity has recently been expanded and a new animal feed plant has been constructed. There are also the usual bakeries and confectionary operations found in all communities.

Qatar possesses minor meat packing and dairy operations, in addition to bakeries and other local supply facilities. Saudi Arabia has the most extensive set of processing facilities in the region. Table 5-12 provides an indication of existing and planned operations. The table indicates a diverse set of activities, with significant expansion of capacity planned. Firms enumerated in this list are major producers, not small local neighbourhood establishments. No information on food processing activities was obtained for the United Arab Emirates.

5-9. TRADE IN AGRICULTURAL PRODUCTS

Data available from UNIDO on computer tapes were used to prepare tables of agricultural products and imports into the GCC region, and the results of an analysis of these tables are summarized in the present section. Live animal imports into the region increased markedly from 1978 to 1980, the total increasing from 266.5 million U.S. dollars to 510.7. The major category of imports was sheep, lambs, and goats, which accounted for over 80 percent of the total. Cattle and poultry were the two other significant categories of live animal imports. Similarly, meat and dairy products experienced almost a doubling of import value -- from 342.1 to 647.6 and from 326.4 to 566.1 millions of U.S. dollars, respectively.

Imports of cereal grains consisted principally of rice in 1978. Rice accounted for approximately 45 percent, by value, of the total cereal imports of 691 million dollars in that year. The dollar value of rice was roughly the same in 1981 as in 1978, but rice's share of total cereal imports had declined to approximately 25 percent. Barley and corn imports had increased markedly over the period, primarily in Saudi Arabia. Although wheat imports doubled in value for the region, they experienced nowhere near the absolute or percentage increase of barley and corn. Very little wheat flour is imported by any country other than Saudi Arabia. The marked increase in the import of feed grains reflects the rapid expansion of poultry production in the region. Further expansion of the livestock sector may reduce the need to import meat, but will require major increases in the import of feed grains.

Other commodities, such as fruits and vegetables, sugar, oilseeds, and animal feedstuffs, experienced significant increases in the value of production over the 1978-1980 period. However, these increases were not as large as for the cereals and meat products groups. The share of food and feed of various types in the total import bill of the region increased from 8.6 percent to 10.6 percent. At the same time, total imports into the region went from 28,940.1 million to 43,117.8 million U.S. dollars.

Agricultural machinery imports into the GCC region increased from 95.2 million dollars to 178.9 million between 1978 and 1980. The bulk of these purchases were made by Saudi Arabia, with 71.3 percent of the total in 1978 and 89.2 percent in 1980. Surprisingly, Kuwait imported 19.5 percent in 1978 and 5.8 percent in 1980, to take the second position. Tractors constituted the biggest share of purchases by Saudi Arabia, Oman, and the UAE, with tillage implements taking a distant second place. The bulk of the Kuwait purchases were coded as other agricultural machinery, possibly for poultry production. The share of agricultural machinery in total imports increased from .3 to .4 percent over the 1978-80 period.

5-10. FOOD SECURITY AND FOOD SELF-SUFFICIENCY

The concept of food security as a national objective has been raised at various points in the foregoing discussion. An articulated objective of investment in agricultural production in the region is to achieve food security by achieving self-sufficiency. The bulk of the material presented in this chapter suggests that this will be a difficult, although not impossible task. With sufficient allocation of resources to agriculture, the region could become self-sufficient. The costs, however, would be astronomical. In order to achieve self-sufficiency, vast amounts of money and fuel would have to be allocated to providing the equipment and water to produce the crops and livestock for consumption. Tables 5-13 through 5-26 provide information on self supply levels for various commodities in the countries of the GCC, using 1974-78 production and consumption estimates. These tables point up the fact that, with the notable exception of dates, fish, fruits, and vegetables, the levels of sustainable self supply are rather low. Although the tables indicate that self supply ratios for eggs, meat, and poultry are relatively high, these commodities cannot be produced in volume without feed grains. Thus, without an indigenous source of feed this latter group of commodities should not, realistically, be considered to be in secure supply.

Saudi Arabia has the greatest degree of self-sufficiency. The 20.6 percent self supply ratio for wheat reported in Table 5-13 for 1974-78 is now probably on the order of 80 percent. Even for Saudi Arabia, in isolation, the cost of increasing output to meet self-sufficiency requirements would be high. Moreover, the target of self-sufficiency is not fixed. As population grows, and its wealth increases, demand will also increase. Thus a level of output that may have fed the population of ten years ago with a diet based on a lower level of income will not feed the current population. To achieve self-sufficiency, output must grow at a faster rate than consumption.

Table 5-10 indicated that the share of resources going to agricultural development in the various countries was declining. Also, as reported in Section 5-9, imports of food and feeds have been growing at a faster rate than imports of machinery. If a policy of self-sufficiency is the objective, these trends will have to be reversed. To do so will impose significant costs on the region, both in direct expenditure and in terms of resource allocation. The major cost in terms of resources will be the production of water for use in agriculture. The cost of this water will be far higher than the world market value of any cereal crops produced using it.

Security of supply is surely an important goal, but at what point do the costs of reaching it exceed the benefits? Security can be obtained in a number of ways. Possible options are long-term purchase agreements from a number of suppliers. These could be used in conjunction with expanded storage facilities to build up buffer stocks. Development of domestic livestock species, such as the camel, to provide meat using rough pasture rather than poultry eating imported grains would reduce the effects of a major impediment to food security. Expansion of domestic production should be considered, but as one of a broad set of objectives if a major misallocation of resources is to be avoided.

As with agricultural processing, the input supply sector is oriented primarily towards import substitution, and not exports. There is, however, the opportunity for exports of fertilizer. Also, as the domestic demand for modern equipment grows, there will be potential for a considerable expansion of the farm machinery sector, particularly implement production. Growth of the implement industry would, of course, be conditional on the planned expansion of agricultural production taking place.

5-11. CONCLUSIONS

Although the initial resource base and climatic conditions of the GCC region are not favourable for agricultural production, there is considerable potential for expansion from existing levels of output. Over the past decade, the output of crops and livestock has shown a marked increase. In spite of this increase, net imports have risen because population and income levels have increased at faster rates. The GCC countries have indicated a commitment to expanding the agricultural sector. While this is clearly possible, such an expansion should be approached with caution.

Experience in other countries and regional groups, such as the United States, Canada, and the European Economic Community, provides evidence of the dangers inherent in subsidizing agriculture. Short-term subsidies distort production decisions and resource allocation. They also result in the creation of vested interest groups which are often able to perpetuate a subsidy scheme even when it provides no benefits to society. While food security is an important objective, the costs inherent in stimulating agricultural production through massive subsidies should be weighed very carefully.

Caution is advisable for two reasons. The first is the high opportunity cost of water. Water allocated to agriculture produces outputs that have relatively low market values in world trade, whereas water allocated to other activities can produce higher-value outputs. Where water is expensive, the value of the crops or livestock produced could be less than the value of the water input. Secondly, increases in agricultural production will require major increases in the skill level of the agricultural labour force. Skilled labour is typically in short supply in the GCC region. Without the use of skilled labour, advanced technology can easily destroy the existing resource base. Thus, the costs of increasing agricultural production could be high.

The objectives of increasing production are to diversify the economy and to provide increased food security. In all of the GCC countries, agriculture represents a declining share of GNP. Only in Saudi Arabia and Oman is there a sufficiently large agricultural population and physical resource base that expansion could provide a meaningful degree of diversification. Even in these countries, output potential is not sufficiently high to provide much of a security buffer.

Current conditions in world trade of agricultural commodities suggest that security measures could be achieved at less cost by building large buffer stocks of storable commodities, such as powdered milk, grains, legumes, sugar, etc. At the same time, if domestic production were concentrated in non-storable commodities, such as vegetables and fluid milk, both objectives of security and growth could be satisfied. Agriculture would be stimulated, but in the production of high-value crops, and security would be achieved through the purchase of low-priced staples.

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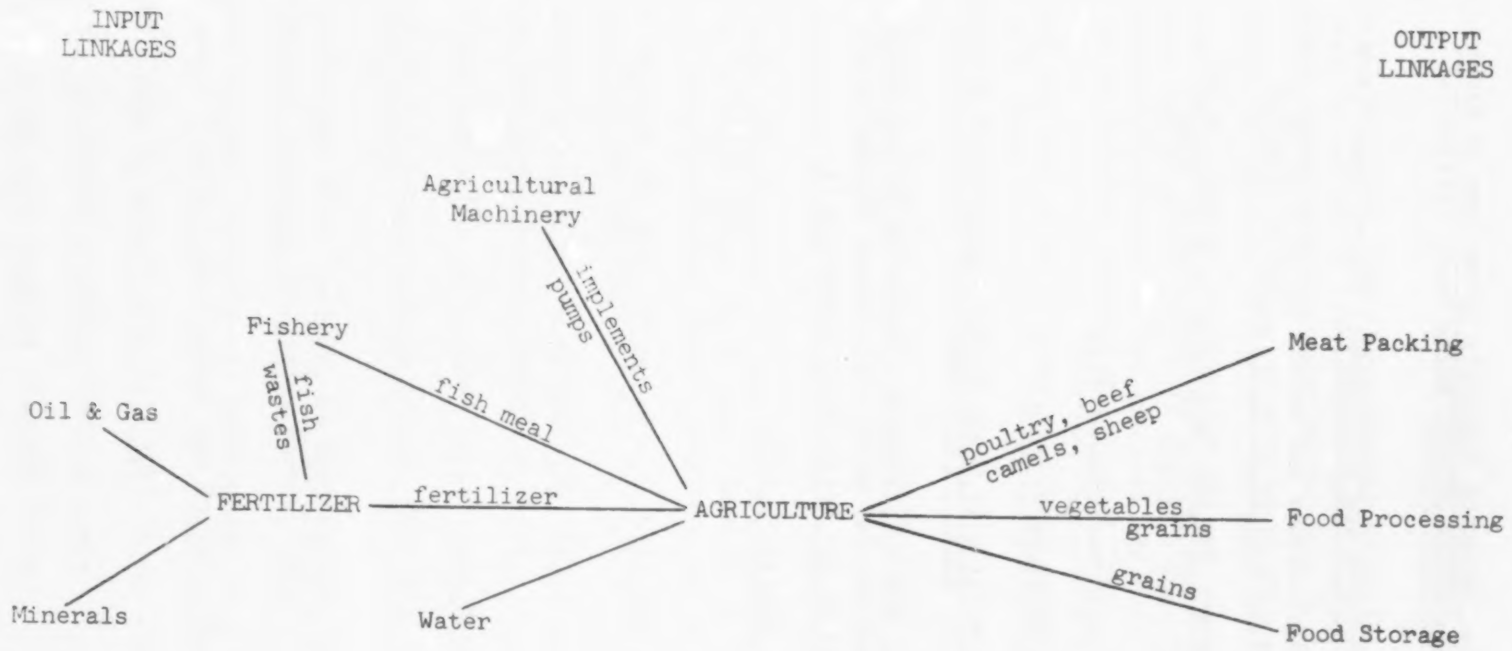
INPUT LINKAGES
OUTPUT LINKAGES
Agricultural Machinery
implements
pumps
Fishery
fish
wastes
fish meal
Oil & Gas
FERTILIZER
fertilizer
Minerals
Water
AGRICULTURE
poultry, beef
camels, sheep
Meat Packing
vegetables
grains
Food Processing
grains
Food Storage

AGRICULTURAL SECTOR LINKAGES

FIGURE 5-1

TABLE 5-1: LAND AREA IN THE COUNTRIES OF THE GCC REGION (THOUSANDS OF HECTARES)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
					Saudi Arabia					
Land Area	214,969	214,969	214,969	214,969	214,969	214,969	214,969	214,969	214,969	214,969
Arable & Perm. Crops	878	952	1,030	1,115	805	1,110	1,104	1,105	1,105	1,105
Arable Land	811	885	960	1,035	730	1,040	1,040	1,040	1,040	1,040
Permanent Crops	67	67	70	80	75	70	64	65	65	65
Permanent Pasture	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000
Arable (a) irrigated	350	360	370	375	390	390	390	395	395	395
(b) nonirrigable										
					Qatar					
Land Area	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Arable & Perm. Crops	2	2	2	2	2	2	2	2	2	2
Arable Land	2	2	2	2	2	2	2	2	2	2
Permanent Crops	--	--	--	--	--	--	--	--	--	--
Permanent Pasture	50	50	50	50	50	50	50	50	50	50
Arable (a) irrigated	--	--	--	--	--	--	--	--	--	--
(b) nonirrigated										
					Oman					
Land Area	21,246	21,246	21,246	21,246	21,246	21,246	21,246	21,246	21,246	21,246
Arable & Perm. Crops	36	36	37	36	36	39	40	36	41	41
Arable Land	16	16	16	16	16	17	17	16	18	18
Permanent Crops	20	20	21	20	20	22	23	20	23	23
Permanent Pasture	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Arable (a) irrigated	--	--	--	35	--	--	37	--	--	38
(b) nonirrigated										

(Continued...)

TABLE 5-1: (Continued...)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
					Kuwait					
Land Area	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
Arable & Perm. Crops	1	1	1	1	1	1	1	1	1	1
Arable Land	1	1	1	1	1	1	1	1	1	1
Permanent Crops	—	--	--	—	—	—	—	—	—	—
Permanent Pasture	134	134	134	134	134	134	134	134	134	134
Arable (a) irrigated	1	1	1	1	1	1	1	1	1	1
(b) nonirrigable										
					Bahrain					
Land Area	62	62	62	62	62	62	62	62	62	62
Arable & Perm. Crops	2	2	2	2	2	2	2	2	2	2
Arable Land	1	1	1	1	1	1	1	1	1	1
Permanent Crops	1	1	1	1	1	1	1	1	1	1
Permanent Pasture	4	4	4	4	4	4	4	4	4	4
Arable (a) irrigated	1	1	1	1	1	1	1	1	1	1
(b) nonirrigated										
					U.A.E.					
Land Area	8,360	8,360	8,360	8,360	8,360	8,360	8,360	8,360	8,360	8,360
Arable & Perm. Crops	12	12	11	12	12	12	11	12	12	13
Arable Land	7	7	6	7	7	7	6	7	7	6
Permanent Crops	5	5	5	5	5	5	5	5	5	7
Permanent Pasture	200	200	200	200	200	200	200	200	200	200
Arable (a) irrigated	5	5	5	5	5	5	5	5	5	5
(b) nonirrigated										

SOURCE: FAO Production Yearbook, various issues, 1976-1981.

NOTE: Data on irrigation relate to areas purposely provided with water, including land flooded by river water for crop production or pasture improvement, whether this land is irrigated several times or only once during the year stated. FAO Production Yearbook, 1981, p.3.

TABLE 5-2: LAND UTILIZATION IN THE GCC STATES, 1971, 1975, AND 1980 (PERCENTAGES)

	1971		1975		1980	
	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category
			Bahrain			
Total Land	100.0	.03	100.0	.03	100.0	.03
Arable and Permanent Crop	3.2	.2	3.2	.2	3.2	.2
Arable	1.6	.1	1.6	.1	1.6	.1
Permanent Crop	1.6	1.0	1.6	1.0	1.6	1.0
Permanent Pasture	6.4	...	6.4	...	6.4	...
Irrigated	1.6	.3	1.6	.3	1.6	.2
			Kuwait			
Total Land	100.0	.7	100.0	.7	100.0	.7
Arable and Permanent Crop	.1	.1	.1	.1	.1	.1
Arable	.1	.1	.1	.1	.1	.1
Permanent Crop	...	...	...	...	...	...
Permanent Pasture	7.5	.2	7.5	.2	7.5	7.5
Irrigated	.1	.3	.1	.3	.1	.2

(Continued...)

TABLE 5-2: (Continued...)

	1971		1975		1980	
	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category
Oman						
Total Land	100.0	8.6	100.0	8.6	100.0	8.6
Arable and Permanent Crop	.2	3.9	.2	4.2	.2	3.5
Arable	.1	1.9	.1	2.1	.1	1.7
Permanent Crop	.1	21.5	.1	20.0	.1	24.0
Permanent Pasture	4.7	1.2	4.7	1.2	4.7	1.2
Irrigated	n.a.	n.a.	n.a.	n.a.	.2	8.6
Qatar						
Total Land	100.0	.4	100.0	.4	100.0	.4
Arable and Permanent Crop	.2	.2	.2	.2	.2	.2
Arable	.2	.2	.2	.2	.2	.2
Permanent Crop	...	...	...	...	...	...
Permanent Pasture	4.5	.1	4.5	.1	4.5	.1
Irrigated	n.a.	n.a.	n.a.	n.a	n.a.	n.a.

(Continued...)

TABLE 5-2: (Continued...)

	1971		1975		1980	
	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category	Internal Land Distribution	Share of GCC Total for Category
			Saudi Arabia			
Total Land	100.0	86.9	100.0	86.9	100.0	86.9
Arable and Permanent Crop	.4	94.3	.4	93.8	.5	94.9
Arable	.4	96.9	.3	97.9	.5	97.3
Permanent Crop	...	72.0	...	75.0	...	...
Permanent Pasture	39.4	98.4	39.5	98.4	39.5	98.4
Irrigated	.2	98.0	.2	98.2	.2	89.8
			UAE			
Total Land	100.0	3.4	100.0	3.4	100.0	3.4
Arable Land Permanent Crop	.1	1.3	.1	1.4	.1	1.1
Arable	.1	.8	.1	.9	.1	.6
Permanent Crop	.1	5.3	.1	5.0	.1	7.3
Permanent Pasture	2.4	.2	2.4	.2	2.4	.2
Irrigated	.1	1.4	.1	1.3	.1	1.1

SOURCE: Based on data in Table 5-1.

TABLE 5-3: TOTAL POPULATION, AGRICULTURAL POPULATION, AND POPULATION ECONOMICALLY ACTIVE IN AGRICULTURE, IN THOUSANDS, FOR SELECTED YEARS, 1970-1980 (BLANKS INDICATE DATA NOT AVAILABLE)

			Bahrain		
Year	1970	1975	1978	1979	1980
Total Population	220	260	280	290	360
Agricultural Population					3
Percent of Total Population					.8
Economically Active in Agriculture					
Percent of Total Population					
Percent of Agricultural Population Economically Active					
			Kuwait		
Year	1970	1975	1978	1979	1980
Total Population	740	1,002	1,215	1,279	1,353
Agricultural Population	13	17	21	22	23
Percent of Total Population	1.8	1.7	1.7	1.7	1.7
Economically Active in Agriculture	4	5	6	6	6
Percent of Total Population	.5	.5	.5	.5	.4
Percent of Agricultural Population	30.8	29.4	28.5	27.3	26
Economically Active	241	286	329	344	360
			Oman		
Year	1970	1975	1978	1979	1980
Total Population	678	766	839	865	891
Agricultural Population	442	494	527	538	550
Percent of Total Population	65.2	64.5	62.8	62.2	61.7
Economically Active in Agriculture	120	131	138	139	142
Percent of Total Population	17.7	17.1	16.4	16.1	15.9
Percent of Agricultural Population	27.1	26.5	26.2	25.8	25.8
Economically Active	177	203	218	224	230

(Continued...)

TABLE 5-3: (Continued...)

Qatar

Year	1970	1975	1978	1979	1980
Total Population	110	170	200	210	220
Agricultural Population					
Percent of Total Population					
Economically Active in Agriculture					
Percent of Total Population					
Percent of Agricultural Population Economically Active					

Saudi Arabia

Year	1970	1975	1978	1979	1980
Total Population	6,200	7,180	7,870	8,110	8,370
Agricultural Population	4,090	4,534	4,822	4,929	5,033
Percent of Total Population	66	63.1	61.3	60.8	60.1
Economically Active in Agriculture	1,122	1,205	1,258	1,278	1,299
Percent of Total Population	18.1	16.8	16.0	15.8	15.5
Percent of Agricultural Population Economically Active	1,699	1,909	2,052	2,104	2,160

United Arab Emirates

Year	1970	1975	1978	1979	1980
Total Population	230	560	710	750	800
Agricultural Population				16	
Percent of Total Population				2.1	
Economically Active in Agriculture		13			
Percent of Total Population					
Percent of Agricultural Population Economically Active					

SOURCE: FAO *Production Yearbook*, 1976-1980.
Saudi Arabia, Chamber of Commerce and Industry, *Future Prospects of Economic Integration in the Gulf Cooperation Council Region* (Riyadh: 1982) (Arabic).
"Agriculture and Food Industries in the UAE", *First Symposium on Food Security and Food Industries in the Arab Gulf and Arab Peninsula*, UAE, 1981, p.16.

TABLE 5-4: SECTORAL LABOUR DISTRIBUTION FOR SELECTED COUNTRIES
(THOUSANDS OF WORKERS)

Country	Year	Agriculture	Industry	Service	Total
Kuwait	1980	8	133	238	378
Saudi Arabia	1980	1,669	350	673	2,692
United Arab Emirates	1979	16			485

SOURCE: The Arab League, The Arab Monetary Fund, and The Arab Fund for Economic and Social Development, The Unified Arab Economic Report 1981.

UAE, Ministry of Planning, Annual Report 1980.

TABLE 5-5: DOMESTIC AGRICULTURAL PRODUCTION IN THE GCC, 1970-1981 (AGRICULTURE, FORESTS AND FISHERIES) IN MILLIONS OF CURRENT US $

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
UAE	16.9	20.3	26.4	38.8	52.5	83.1	109.3	125.8	156.0	178.2	223.1	234.6
Bahrain	2.1	2.5	3.0	16.3	19.8	26.3	27.3	34.9	41.6	51.6	73.8	85.4
Saudi Arabia	218.7	235.1	255.4	307.6	350	395	449.4	529.3	1,149.9	1,248.5	1,397.2	1,648.3
Oman	39.8	40.4	44.3	47.6	50.4	58.5	62.0	69.5	78.5	92.6	107.4	133.8
Qatar	5.4	7.2	9.2	10.8	16.1	19.1	22.9	18.8	27.4	33.2	45.5	46.7
Kuwait	8.2	8.9	11.5	16.0	20.2	23.5	35.2	45.7	49.2	60.4	64.7	62.1
GCC TOTAL	291.1	314.4	349.8	437.1	509	605.5	706.1	824	1,502.6	1,664.5	1,911.7	2,210.9

SOURCE: GCC, *National Accounts*, 1970-1981.

TABLE 5-6: PRINCIPAL TREE CROP PRODUCTION, SELECTED YEARS
(THOUSANDS OF METRIC TONS)

Dates (Tonnes)	1969-71	1975	1978	1979	1980
Bahrain	15	16	38	38	38
Kuwait	...	...	1	1	1
Oman	44	55	51	52	53
Qatar	n.a.	n.a.	n.a.	n.a.	3
Saudi Arabia	161	140	210	215	205
UAE	8	n.a.	39	40	51
GCC Total	228	211	339	346	351

Lemons & Other Citrus (Tonnes)					
Bahrain	1	1	1	1	1
Kuwait	...	...	...	...	...
Oman	9	12	13	14	14
Qatar	...	...	...	...	.33
Saudi Arabia	n.a.	6	29	19	29
UAE	19	n.a.	4	9	4
GCC Total	n.a.	n.a.	47	53	48.33

SOURCE: FAO Production Yearbook, various issues, and Qatar, Agricultural Statistics Yearbook, 1980.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 5-7: PRINCIPAL CEREAL CROPS, AREA PLANTED, YIELD, AND PRODUCTION IN OMAN AND SAUDI ARABIA, SELECTED YEARS

	1969-71	1975	1978	1979	1980
Oman					
Total Cereals					
area	3	5	4	4	4
yield	1.2	.97	1.47	1.52	1.52
production	4	5	6	6	6
Wheat					
area	1	3	2	2	2
yield	1.63	.98	1.94	2.0	2.0
production	2	3	4	4	4
Barley	n.a.	n.a.	n.a.	n.a.	n.a.
Sorghum	n.a.	n.a.	n.a.	n.a.	n.a.
Saudi Arabia					
Total Cereals					
area	357	345	406	424	424
yield	1.21	.84	.75	.67	.68
production	430	289	304	283	285
Wheat					
area	57	62	60	85	85
yield	1.78	2.13	2.0	1.8	1.8
production	101	132	120	150	150
Barley					
area	14	7	8	10	10
yield	.9	2.4	1.9	1.6	1.6
production	13	17	15	16	16
Sorghum					
area	174	237	302	290	290
yield	1.06	.54	.50	.35	.35
production	185	128	152	100	100

SOURCE: FAO *Production Yearbook*, various issues.

NOTE: Area - '000 hectares; yield - tonnes/ha; production - '000 tonnes; n.a. indicates "not available."

TABLE 5-8: SELECTED FRUIT AND VEGETABLE PRODUCTION STATISTICS IN THE GCC COUNTRIES, SELECTED YEARS

		1970	1975	1978	1979	1980
Tomatoes						
Bahrain						
	yield	23.7	26.00	50	50	50
	production	2	3	9	10	10
Kuwait						
	yield	10.5	19.0	25.3	25.2	21.1
	production	2	4	10.9	11.6	11
Qatar						
	yield	n.a.	n.a.	n.a.	n.a.	17.6
	production	n.a.	n.a.	n.a.	n.a.	6
Saudi Arabia						
	yield	12.5	10.0	10.0	10.0	10.7
	production	100	112	180	181	167
UAE						
	yield	17.3	n.a.	34	34	46
	production	9	n.a.	22	22	36
Sweet Melons						
Bahrain						
	yield	50.0	56.0	84.6	81.4	88
	production	1	1	2	2	2
Kuwait						
	yield	24.4	n.a.	22.5	67.5	n.a.
	production	4	n.a.	4.5	2.7	5
Qatar						
	yield	n.a.	n.a.	n.a.	n.a.	7.7
	production	n.a.	n.a.	n.a.	n.a.	2
Saudi Arabia						
	yield	32.7	n.a.	8.5	8.5	17.4
	production	9	n.a.	12	12	16
UAE						
	yield	27	n.a.	24.4	24.4	22
	production	n.a.	n.a.	1	1	15

(Continued...)

TABLE 5-8: (Continued...)

		1969-71	1975	1978	1979	1980
Water Melons						
Bahrain						
	yield	n.a.	n.a.	85	60	n.a.
	production	n.a.	n.a.	1	1	1
Qatar						
	yield	n.a.	n.a.	n.a.	n.a.	8
	production	n.a.	n.a.	n.a.	n.n.	9
Saudi Arabia						
	yield	34.2	n.a.	20.8	20.8	13.3
	production	505	n.a.	260	260	140
UAE						
	yield	8.0	n.a.	35.7	35.7	31.0
	production	1	n.a.	9	9	25.5
Total Production (000 MT)						
Bahrain	Veg. & Melons	4	9	25	26	27
	Fruit	18	19	42	42	42
Kuwait	Veg. & Melons	15	16	31	32	33
	Fruit	1	1	1	1	1
Oman	Veg. & Melons	6	8	8	8	8
	Fruit	65	79	82	83	95
Qatar	Veg. & Melons	23	31	37	39	n.a.
	Fruit	2	2	2	2	n.a.
Saudi Arabia	Veg. & Melons	674	436	598	600	523
	Fruit	259	434	438	446	520
UAE	Veg. & Melons	24	n.a.	73	73	75
	Fruit	28	n.a.	76	77	78
GCC	Veg. & Melons	746	n.a.	772	778	666
	Fruit	373	n.a.	641	651	726

SOURCE: FAO Production Yearbook, various issues, Qatar Agricultural Statistics Yearbook, 1980; UAE Statistical Yearbook, 1980; Kuwait Statistical Yearbook, 1980.

NOTE: yield -- MT/ha; production -- '000MT.

TABLE 5-9: NUMBERS OF LIVESTOCK IN THE GCC COUNTRIES, 1976, 1977, and 1978 (THOUSANDS OF ANIMALS)

Country	Year	Cows	Sheep	Goats	Camels
Bahrain	1976	5	3	13	1
	1977	5	3	13	1
	1978	5	3	13	1
Kuwait	1976	5	13	2	5
	1977	6	18	2	6
	1978	6	25	2	6
Oman	1976	134	76	194	6
	1977	135	77	197	6
	1978	136	78	201	6
Qatar	1976	10	38	42	9
	1977	10	39	39	9
	1978	6	42	49	9
Saudi Arabia	1976	321	2,243	1,577	107
	1977	360	2,300	1,600	107
	1978	400	2,600	1,700	108
UAE	1976	16	74	270	60
	1977	19	95	250	48
	1978	23	120	311	53
GCC Total	1976	491	2,447	2,098	188
	1977	535	2,532	2,101	129
	1978	578	2,868	2,276	183

SOURCE: ECWA, Economic Indicators in the Arab World, pp. 103-107.

TABLE 5-10: AGRICULTURAL AND TOTAL DEVELOPMENT EXPENDITURES BY THE GCC COUNTRIES, 1970-1980
(MILLIONS OF US DOLLARS)

Country	Agriculture			Total			Agriculture as Percent of Total		
	1970-75	1975-80	1970-80	1970-75	1975-80	1970-80	1970-75	1975-80	1970-80
Bahrain	...	10	10	...	377	377	...	2.7	2.7
Kuwait	22	113	135	2,554	16,708	19,262	.9	.7	.7
Oman	24	165	189	1,305	3,926	5,231	1.8	4.2	3.6
Qatar	n.a.	n.a.	n.a.	3,472	4,584	8,020	n.a.	n.a.	n.a.
Saudi Arabia	444	1,332	1,776	7,280	90,520	97,800	6.1	1.5	1.8
United Arab Emirates	164	191	355	3,472	4,584	8,020	4.7	4.2	4.4

SOURCE: The Arab League, The Arab Monetary Fund, and The Arab Fund for Economic and Social Development, The Unified Arab Economic Report, 1981, p.293-94.

NOTE: ... indicates "negligible"; n.a. indicates "not available".

TABLE 5-11: FERTILIZER PRODUCTION CAPACITY IN THE GCC REGION IN 1982 (THOUSANDS OF TONS PER YEAR)

Type of Fertilizer	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Total
Urea	0	660	0	660	300	0	1,620
Ammonia	0	790	0	594	200	0	1,584
Ammonia Sulphate	0	195	0	0	0	0	195

SOURCE: N.J. Dabdab and B.I. Mohyuddin, "Oil Based and Non-oil Based Industrial Development in the Arab Gulf Region," unpublished paper, October 1982.

TABLE 5-12: SELECTED LICENSED FOOD PROCESSING FACTORIES IN SAUDI ARABIA, 1980

Type	Principal Products	Number of Operational Factories	Number Under Construction	Number Planned	Total
Livestock	Eggs, broilers	5	4	2	11
Meat Packing	Poultry, beef, sheep and camels - cutting, wrapping, processing, freezing	6	9	3	18
Dairy	Raw milk, pasteurized milk, butter, ice cream, cheese, yoghurt	29	21	28	78
Fruit and Vegetable Processing	Fruit juices from concentrate; water bottling; tomato paste, juice and ketchup; jams; date packing; canned vegetables	14	6	10	30
Bakeries	Bread, rolls, macaroni and processed rice	46	26	21	93
Sugar Refineries	Sugar	0	0	2	2
Cocoa, Chocolate and Confectionaries	Cocoa, chocolate and confectionary items	8	2	3	13
Ice	Ice and cold storage	37	12	14	63
Beverages	Carbonated beverages, fruit juices, mineral and carbonated water	19	3	14	36
Feed Mills	Poultry and cattle feed	8	0	3	11

SOURCE: Saudi Arabia, Ministry of Industry and Electricity, A List of Licensed Factories and Industrial Licences Issued Under the National Industries Protection and Encouragement Law and Foreign Investment Law up to 1980.

TABLE 5-13: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF WHEAT IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	...	...	95,300	92,460	0
Bahrain	...	...	17,817	17,283	0
Qatar	...	...	[illegible]	19,412	0
United Arab Emirates	...	...	89,907	88,953	0
Saudi Arabia	123,000	150,000	592,176	579,814	20.6
Oman	3,200	4,000	58,022	57,470	5.5
GCC Total	126,200	154,000	873,826	855,392	14.4

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: **Present Status and Future Prospects**," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.38.

NOTE: ... indicates "negligible".

TABLE 5-14: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF BARLEY IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	...	...	[illegible]	24,988	0
Bahrain	...	...	[illegible]	847	0
Qatar	...	...	[illegible]	3,262	0
United Arab Emirates	...	...	3,965	3,767	0
Saudi Arabia	16,200	16,000	56,906	53,225	28.5
Oman	n.a.	n.a.	n.a.	n.a.	n.a.
GCC Total	16,200	16,000	91,500	86,089	17.7

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.39.

NOTE: ... indicates "negligible"; the "GCC Total" is the sum of figures available; n.a. indicates "not available".

TABLE 5-15: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF RICE IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	...	...	54,652	54,105	0
Bahrain	...	...	20,774	18,697	0
Qatar	...	...	10,638	10,532	0
United Arab Emirates	...	...	62,542	61,917	0
Saudi Arabia	...	3,000	190,540	188,635	1.6*
Oman	...	...	30,160	29,858	0
GCC Total	...	3,000	369,306	363,744	.8*

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.40.

NOTE: *Self-supply ratio calculated using 1979 production; ... indicates "negligible".

TABLE 5-16: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF CORN IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	...	...	22,278	21,387	0
Bahrain	n.a.	...	n.a.	n.a.	n.a.
Qatar	n.a.	...	n.a.	n.a.	n.a.
United Arab Emirates	...	...	506	481	0
Saudi Arabia	4,600	4,000	130,114	123,369	3.5
Oman	...	...	1,786	1,715	0
GCC Total	4,600	n.a.	154,684	146,519	n.a.

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.41.

NOTE: n.a. indicates "not available"; ... indicates "negligible"; the GCC Total is the sum of figures available.

TABLE 5-17: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF VEGETABLES IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	23,400	n.a.	61,250	55,125	38.2
Bahrain	16,800	n.a.	27,365	24,628	61.4
Qatar	33,000	n.a.	36,331	32,698	90.8
United Arab Emirates	21,800	n.a.	33,676	30,308	61.7
Saudi Arabia	476,400	n.a.	507,391	456,076	93.9
Oman	7,800	n.a.	7,800	7,020	100.0
GCC Total	579,200	n.a.	673,813	605,855	86.0

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 2[illegible]-May 2, 198[illegible], p.43.

NOTE: n.a. indicates "not available".

TABLE 5-18: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF FRUITS IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	1,000	1,000	78,308	71,733	1.3
Bahrain	28,600	42,000	39,865	37,385	71.7
Qatar	n.a.	2,000	1,456	1,383	137.4*
United Arab Emirates	12,000	n.a.	47,546	44,208	25.2
Saudi Arabia	341,200	446,000	503,968	467,576	69.7
Oman	74,600	n.a.	76,920	72,250	97.0
GCC Total	457,400	491,000	748,063	694,535	61.1

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects." First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.44, with corrections.

NOTE: n.a. indicates "not available"; * indicates self-supply ratio calculated using 1979 production figure; the GCC Total is the sum of figures available.

TABLE 5-19: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF DATES IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	1,000	n.a.	6,642	6,310	15.1
Bahrain	27,600	n.a.	27,618	26,237	99.9
Qatar	n.a.	n.a.	1,456	1,383	n.a.
United Arab Emirates	12,000	n.a.	13,868	13,175	86.5
Saudi Arabia	268,800	n.a.	261,504	248,429	102.8
Oman	50,200	n.a.	52,800	5,860	95.1
GCC Total	359,600	n.a.	363,888	301,394	98.8

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.45, with corrections.

NOTE: n.a. indicates "not available"; the GCC Total is the sum of figures available; the ratio reported in column 5 is logically bounded between 0 and 1, which means the figure reported for Saudi Arabia is in error.

TABLE 5-20: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF LEGUMES IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	n.a.	n.a.	6,163	5,855	n.a.
Bahrain	...	n.a.	1,231	1,169	0
Qatar	...	n.a.	465	442	0
United Arab Emirates	...	n.a.	4,962	4,714	0
Saudi Arabia	5,000	n.a.	20,832	19,548	24.0
Oman	...	n.a.	1,980	1,881	0
GCC Total	n.a.	n.a.	35,633	33,609	n.a.

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects", First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p. 46.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 5-21: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF RED MEAT IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	25,720	n.a.	64,148	64,148	40.1
Bahrain	2,800	n.a.	10,916	10,916	25.6
Qatar	3,600	n.a.	8,857	8,857	40.6
United Arab Emirates	7,560	n.a.	32,174	32,174	23.5
Saudi Arabia	77,840	n.a.	169,329	169,329	46.0
Oman	6,520	n.a.	13,176	13,176	49.5
GCC Total	124,040	n.a.	298,600	298,600	41.5

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects", First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p. 47, with corrections.

NOTE: n.a. indicates "not available".

TABLE 5-22: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF FISH IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	4,810	n.a.	8,028	8,028	59.9
Bahrain	2,980	n.a.	4,327	4,327	68.8
Qatar	2,517	n.a.	2,517	2,517	100.0
United Arab Emirates	66,200	n.a.	66,200	66,200	100.0
Saudi Arabia	22,075	n.a.	34,770	34,770	63.5
Oman	193,705	n.a.	193,705	193,705	100.0
GCC Total	292,287	n.a.	309,547	309,547	94.4

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects", First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p. 49, with corrections.

NOTE: n.a. indicates "not available".

TABLE 5-23: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF CHEESE IN THE GCC REGION

Country	1 **Average Annual Production 1974-1978 (metric tons)**	2 **Domestic Production 1979 (metric tons)**	3 **Average Annual Supply 1974-1978 (metric tons)**	4 **Average Annual Consumption 1974-1978 (metric tons)**	5 **Self-Supply Ratio (percent) 100 x 1 ÷ 3**
Kuwait	...	n.a.	6,892	6,892	0
Bahrain	...	n.a.	1,453	1,403	0
Qatar	...	n.a.	661	661	0
United Arab Emirates	...	n.a.	2,634	2,634	0
Saudi Arabia	n.a.	n.a.	16,243	16,243	n.a.
Oman	30	n.a.	280	280	10.7
GCC Total	n.a.	n.a.	28,163	28,122	n.a.

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects", First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p. 50.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 5-24: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF POULTRY IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	8,200	n.a.	24,529	24,529	33.4
Bahrain	1,600	n.a.	4,435	4,435	36.1
Qatar	...	n.a.	4,104	4,104	0
United Arab Emirates	700	n.a.	16,285	16,280	3.7
Saudi Arabia	21,200	n.a.	88,312	88,312	24.0
Oman	1,000	n.a.	4,200	4,200	23.8
GCC Total	32,600	n.a.	141,865	141,860	23.0

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.48.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 5-25: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF EGGS IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	2,280	n.a.	12,579	11,950	18.1
Bahrain	1,280	n.a.	3,218	3,058	39.8
Qatar	...	n.a.	1,120	1,064	0
United Arab Emirates	960	n.a.	9,177	8,718	10.5
Saudi Arabia	14,400	n.a.	23,309	22,144	61.8
Oman	460	n.a.	1,120	1,064	41.1
GCC Total	9,380	n.a.	50,523	47,998	18.6

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects," First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27-May 2, 1981, p.51.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 5-26: PRODUCTION, CONSUMPTION, AND SELF-SUPPLY LEVELS OF SUGAR IN THE GCC REGION

Country	1 Average Annual Production 1974-1978 (metric tons)	2 Domestic Production 1979 (metric tons)	3 Average Annual Supply 1974-1978 (metric tons)	4 Average Annual Consumption 1974-1978 (metric tons)	5 Self-Supply Ratio (percent) 100 x 1 ÷ 3
Kuwait	...	n.a.	43,090	43,090	0
Bahrain	...	n.a.	6,528	6,528	0
Qatar	...	n.a.	5,948	5,948	0
United Arab Emirates	...	n.a.	21,853	21,853	0
Saudi Arabia	n.a.	n.a.	114,875	114,875	n.a.
Oman	...	n.a.	10,448	10,448	0
GCC Total	n.a.	n.a.	202,792	202,792	n.a.

SOURCE: "Food Security and Food Industries in the Arabian Gulf and Peninsula: Present Status and Future Prospects", First Symposium on Food Security and Food Industries in the Arabian Gulf and Peninsula, UAE, April 27 - May 2, 1981, p. 52

NOTE: n.a. indicates "not available";... indicates "negligible".

CHAPTER 6

FISHERIES

6-1. INTRODUCTION

Various studies by the Food and Agriculture Organization of the United Nations (FAO) have shown that the fishery resources of the GCC region are underutilized. In order to diversify the economy and to avoid over-dependence upon imported food supplies, it is important for the region to promote the exploitation of these resources.

Sections 2 to 5 of this chapter discuss the various fishery resources of the region. Sections 2 and 3 describe the general characteristics of fisheries; total potential catch and consumption of each member country are examined. Sections 4 and 5 discuss environmental issues relating to the Arabian Gulf and the utilization of by-catch. Some further aspects of fishery resource development are considered in Section 6.

6-2. GENERAL CHARACTERISTICS OF THE REGION

Over 90 percent of the fish landed in the Region are caught by the artisanal (traditional) fishing methods The remainder is caught by mechanized commercial (or industrial) trawlers. Artisanal fishing methods are skillful and selective, and hence produce only a small by-catch. The yields are comparatively high.

There are approximately 17,990 fishermen and 5,740 fishing boats in the Region. (See Table 6-1 for a country breakdown.)

A considerable proportion of fishing boats are powered by motor. The most common types of boats are the houris (4 to 6 meters in length), the sambuks, and the bigger dhows (15 meters). The value of a smaller boat, including outboard motor, is approximately 5,000 US dollars, and the number of workers per boat is generally two or three. The mechanized large boats are usually valued between 17,000 and 40,000 US dollars and the number of workers per boat varies from five to eight. Drift nets, purse seine nets, shore seine, bottom nets, hook and line, and traps are generally employed.

(a) Total Landing, 1974-1980

Total fish landing in the region has been declining. (Table 6-2 shows the total landing from 1972 to 1981.) This decline is the result mainly of high wages in the oil-related sectors of the economy and the uncertainty of fishermen's incomes, which makes the life-style of a fisherman unattractive. This has created a serious labour shortage in the fishing sector. As a result, although most of the trawlers are owned by local fishermen, they are often crewed by foreign workers.

The characteristics of the fishing industry of each country in the GCC are examined below.

(b) Country Characteristics

BAHRAIN

About 70 percent of the fish landed are caught by artisanal fishing methods, using traditional wire trap ("gargoor"), barrier trap, net, and hook-and-line equipment. Most of the catch is trucked to market at Manama and Sitra.

In 1975, the Bahrain Fishing Company was established by the Government. Modern methods in fishing and processing were adopted. As a result, the total catch has been much higher since 1976. Landing, import, and export statistics of Bahrain are presented in Tables 6-3 and 6-4.

KUWAIT

The original commercial shrimp fleet and other commercial fishing companies were amalgamated in 1972 into the huge United Fisheries of Kuwait Company. This company (40 percent owned by the Government) now operates with a fleet of 140 ships in the Arabian Gulf, the Red Sea, the Indian Ocean, and the Atlantic Ocean. Shrimp and fish processing plants and various freezing and storage facilities are extensive but are underutilized. The majority of the landing in Kuwait still comes from the artisanal fishing sector.

Landing, import, and export statistics of Kuwait are presented in Tables 6-5 and 6-6.

OMAN

The fishery resources off the Omani coastline are extremely rich. The declining catch is attributable mainly to the migration of fishermen to urban areas and neighbouring countries in search of better opportunities.

In the commercial fishing sector, a Japanese company was granted a concession in 1976. The contract was not renewed, but granted instead to a South Korean Company. (The Omani Government receives 30 percent of the catch.) In 1979, it was stated that the existing Government trawlers and the associated shore-based facilities would be taken over by the Oman National Fishing Company and operated on a commercial basis.

Table 6-7 below shows landing statistics for Oman, by species.

QATAR

The Qatar National Fishing Company undertakes most of the commercial fishing activity. Formed in 1966 as an extension of the local shrimp-fishing industry, the company now has a refrigeration and processing plant near Doha capable of handling seven tons of shrimps daily.

Nominal catch statistics reported by the FAO for Qatar for the period 1972 to 1980 are given in Table 6-8. The figures provided by the Qatar Department of Fisheries are somewhat lower (totals of 1,736 and 2,273 metric tons in 1980 and 1981, respectively). The Department of Fisheries also reported that imported fresh fish totalled about 443 metric tons in 1980 and

and 331 tons in 1981.[1]

SAUDI ARABIA

The fishing fleet on the Red Sea coast consists of about 1,200 boats (approximately 4 to 8 meters in length), supporting 2,400 licensed fishermen. In the Arabian Gulf area, the fishing fleet consists of about 200 boats (ranging between 8 and 20 meters in length), supporting about 2,000 licensed fishermen. (Reference 1, p.141).

In 1980, all the fish landed in Saudi Arabia came from the artisanal sector. The Government is currently considering reviving the commercial trawling operations.

Tables 6-9 and 6-10 provide landing statistics by species and import and export statistics for fishery commodity groups in Saudi Arabia, 1970 or 1972 to 1980.

UNITED ARAB EMIRATES

The artisanal fishermen of the UAE are widely dispersed among the villages along the coast. Because of this, basic fishery services, such as port facilities, refrigeration, and repair services, are hard to come by.

As for the commercial fishing sector, fish meal ventures and some of the private trawling ventures had ceased operations at one time. However, with the aid of the Government, there are currently three modern fish processing plants operating. Idle capacity exists in these plants. Table 6-11 provides some landing statistics for the UAE from 1972 to 1980.

6-3. POTENTIAL YIELDS FROM THE ARABIAN GULF, GULF OF OMAN, ARABIAN SEA, AND RED SEA

The Arabian Gulf

(a) General

The Arabian Gulf is surrounded by arid land mass except at its eastern end, which is connected to the Gulf of Oman by the narrow strait of Hormuz. The Arabian Gulf gets little water regulation from the adjacent ocean. Evaporation far exceeds precipitation. As a result, water temperature and salinity are high. This causes considerable stress on marine life.

The plankton biomass is usually an indicator of the marine productivity of the water. The annual mean of plankton biomass is found to be 200 mg per cubic meter for the Arabian Gulf, indicating that the water in the Arabian Gulf is highly productive. (Reference 2, p.3).

(b) Species composition and catch rates

It is typical for tropical water that there is a large variety of species. Table 6-2 shows the major species composition of catch in the Arabian Gulf. In general, a greater quantity of non-commerical demersal species are found on the Iranian side of the Arabian Gulf.

A survey of the catch rates from the different parts of the Arabian Gulf and the Gulf of Oman was carried out by FAO survey vessels, and the results are indicated in the maps of Figures 6-1 and 6-2. Note that the catch rates shown by the survey vessels overestimate actual commercial catch rates. The maps serve to indicate the relative productivity in different parts of the Arabian Gulf and the Gulf of Oman. The catch rates seem to be higher on the Iranian side than on the Arabian side of the Arabian Gulf.

(c) Potential Yield[2]

The FAO survey has provided estimates of potential yields of the Arabian Gulf. (See Table 6-13.) These estimates may be regarded as the best ones available. However, they do not represent accurate predictions of catches that would be made if the resources were exploited to the full. As the stock of fish is subjected to intensive fishing, the estimates might have to be revised substantially, especially when a large number of different species is involved. Most of the directors of fisheries departments in the GCC countries are much less optimistic about the potential yields than the survey estimates would imply.

(d) Shrimp fishery

One of the most important marine resource in the Arabian Gulf is the shrimp fishery. Shortages of supply in the world shrimp industry have caused the world price of shrimp to rise markedly in recent decades, and shrimp has become a very valuable resource. Shrimp fishing in the GCC region takes place almost exclusively in the Arabian Gulf. The average annual production of shrimp in the Arabian Gulf in the period 1976-78 is estimated to have been 9,600 metric ton. (Reference 3, pp.116-119). Approximately one third of the catch is by artisanal fishing methods, the rest coming from large-scale commercial trawling. A large amount of demersal fish is caught as by-catch (unwanted by-products).

The production rate from large-scale commercial shrimp trawling in the GCC region is estimated to have been 150 metric tons/boat/season in 1978 in Qatar, 50 in Saudi Arabia, 153 in Bahrain, and 55 in Kuwait. (Reference 3, pp.116-119).

Shrimp landings over the period 1972-80 are shown in Table 6-14. The decline evidenced by the table apparently is a consequence of very heavy shrimping activities. Unless common access to shrimping is restricted, there is a danger that the resource will cease to exist.

Around 1981, each country in the region imposed a closed season regulation for shrimp fishing, and there are some indications that the total shrimp landing has, indeed, improved. The Bahrain Government reported that commercial shrimp landing increased in 1981, over 1980, by 70 percent. At the same time, the artisanal shrimp landing decreased by 50 percent. (Reference 4).

All known stocks of shrimp are intensively fished. The shrimp resource has apparently reached its maximum potential yield. Most of the shrimp product of the GCC region is exported.

(e) Summary and Conclusion

Summing up, the Arabian Gulf does have the potential to increase its current rate of exploitation of fishery resources. It also has some very valuable species, such as shrimp. Since the Gulf is surrounded by seven countries, co-operation among countries is absolutely necessary for the conservation of the fishery resources (especially the shrimp resource) and of the environment. (See the discussion of environmental pollution problems in section 6-4 below.)

Gulf of Oman

(a) General

The Gulf of Oman has a direct and wide connection with the Arabian Sea. The Gulf itself is very deep and has many of the characteristics of ocean waters. The water temperature and salinity level are lower and more uniform than in the Arabian Gulf. (Salinity averages around 35.5 parts of salt per thousand.) (Reference 2, pp.1-7).

The continental shelf extends principally from Musandam Province in Oman to Muscat, along the Batina coast. The width of the continental shelf decreases as it approaches Muscat, and from Muscat to Ras Al-Hadd it is almost non-existent. The strait of Hormuz constitutes a passage for migratory species between the Arabian Gulf and the Gulf of Oman (especially for the small pelagic species). The sea bottom in the Province of Musandam is hard, with coral and rocks, making certain types of trawling operations infeasible. The coastal sea bottom along the Batina coast is flat, with mud and sand, and here the coast is heavily fished.

There are two monsoon seasons in the Gulf of Oman (and also in the Arabian Sea). The southwest monsoon season (May to September) is a period of high productivity in these areas, since the surface waters are replaced from below by the upswelling of nutrient-rich and oxygen-poor waters. The lack of oxygen is responsible for the occasional mass mortality of fish observed in the Gulf of Oman (and the Arabian Sea). The northeast monsoon season (November to March) is a low-productivity period.

(b) Present Catch and Potential Yield

The statistics on catch and potential yield are based on information gathered from Musandam Province and Gulf of Oman Province (from Khor Kalba to Ras Al-Hadd).

The species composition of the demersal fishery (sea-bottom fishes) is given in Table 6-15. As for the small pelagic species (sardine-like fish), the main ones are oil sardine (sardinella longiceps), sind sardinella (sardinella sindensis), rainbow sardine (dussumieria acuta), anchovy (stolephorus), small horse mackerel (carangidae), and scad (selar crumenophthalmus). The predominant large pelagic species (tuna-like fish) are yellowfin tuna (thunnus albacares), longtail tuna (thunnus tonggol), little tuna (euthynnus affines), skipjack (katsuwonus pelamis), king mackerel (scomberomorus commerson), and hammerhead sharks (sphyrna mokarran).

The mesopelagic species are found in abundant quantity and concentrations in dense layers at about 100-300 meters depth in the Gulf of Oman and the Arabian Sea. The predominant specie is the small lanternfish (myctophids). The mesopelagic species come close to the surface during the night. Their exploitation still poses some technological problems associated with fishing gear, storage, and processing. However, considering the level of international fisheries technology and research capacity today, it should be possible to exploit these resources in the near future.

The Arabian Sea

The Arabian Sea has many regional characteristics similar to those of the Gulf of Oman. There are two monsoon seasons, associated with the southwest and northeast monsoons. The southwest monsoon induces an intense upswelling, creating centers with high productivity. Ras Al-Jibsh, Masira Island, Cape Ras Madraka, Kuria Muria Island, and Salalah are centers of this kind where abundant fishery resources can be found. The continental shelf, which is rich in fishery resources, is also wider than it is in the Gulf of Oman. The exploitation of demersal resources in the continental shelf has been carried out by government trawlers, Japanese trawlers, and currently by Omani/Korean joint-venture fishing operations.

The Arabian Sea has an abundant stock of migratory pelagic and mesopelagic species. Lobster fishing is currently an important industry. Abalones are also detected in the inshore areas of the Arabian Sea, and represent a resource that has not yet been exploited. Table 6-16 summarizes the current state of exploitation and the potential yields of the Arabian Sea.

The predominant small pelagic species are Indian sardine (*sardinella longiceps*), round herring (*etrueus teres*), rainbow sardine (*dussumieria acuta*), anchovy (*stolephorus*), and horse mackerel (*trachurus*). As for the large pelagic species, the predominant species are king mackerel (*scomberomorus guttatus*), longtail tuna (*thunnus tonggol*), little tuna (*euthynnus affines*), hammerhead sharks (*sphyrna mokarran*), and tiger sharks (*galeocerdo cuvieri*).

The Red Sea

The bottom of the Red Sea consists of broad coastal shallow shelves with an average depth of 491 meters. There is a narrow trough which plunges to a depth of more than 2,100 meters in the middle. With little precipitation or stream runoffs, and high evaporation, the salinity of the water is high (averaging 41 parts of salt per thousand). The only source of water replenishment is from the Gulf of Aden. As a result, oxygen concentration in the water is low. Since the Red Sea is an important trade route, traffic is heavy at times. All of these characteristics cause some stress to marine life.

Statistics on the marine resources of the Red Sea are crude. Based on preliminary survey work, the FAO reports that the potential annual yield from the Red Sea is around 160 thousand tons. (Reference 5, p.5). This appears to be roughly double the annual catch of recent years.

Based on survey data for January/February 1980 in the five major fishing centers on the Saudi Arabian coast of the Red Sea (Jizan, Lith, Jeddah, Tuwwal, and Yanbu), the predominant species caught along the coast are kingfish (40 percent of the catch), emperors (10 percent), tuna (10 percent), Indian mackerel (10 percent), jacks (8 percent), sharks (7 percent), and barracuda (5 percent). Of the five major fishing centers, Jizan is the most productive. The combined average daily landing from the five fishing centers in the months of January and February is approximately 10,770 kilograms. In the summer months, the daily catch is three to four times higher. The average daily catch per boat is approximately 22 kilograms in the months of January and February.[3]

Most of the fishing vessels are wooden boats of 4 to 5 meters in length. The two most common kinds are the more expensive sambuks (average price 28,000 US dollars) and the less expensive houris (average price 5,000 US dollars, including motors). The average size of crew is two or three per boat, and the main fishing technique is handlining. There are approximately 2,500 fishermen and 1,200 fishing boats on the Saudi Arabian coastal area of the Red Sea. About 75 percent of the fishermen are Saudi Arabian citizens. There are about 10 boat-building and repair yards in the five fishing centers. Shore-based facilities, such as fish landing ports, ice plants, fuel stations, etc., are lacking in the five centers.[4]

Summary and Concluding Observation

This section has been concerned with the potential yields of marine resources in the waters surrounding the GCC region. The Arabian Sea offers the highest potential yields. Next are the Arabian Gulf and the Gulf of Oman. The Red Sea offers the lowest potential. The Arabian Gulf also has one of the most valuable and exclusive resources, namely the shrimp fishery.

A conservative estimate suggests that output from the GCC fisheries can be increased to at least four times the current level before potential yields are fully realized.[5]

6-4. ENVIRONMENTAL PROBLEMS IN THE ARABIAN GULF

Most of the industrial development in the GCC region has been concentrated in the coastal areas of the Arabian Gulf. Rapid industrialization brings about sharp increases in local population, urbanization, and shipping traffic. All this is happening in a very fragile natural environment.

There are three main environmental concerns relating to the Arabian Gulf: (a) industrial thermal water discharge (sometimes known as thermal pollution); (b) brine discharge from desalination plants; and (c) industrial waste and spills and urban effluent. The extent of industrial pollution in the Arabian Gulf is not known with any accuracy, but it is considered not yet to be critical. In the surrounding waters of the GCC region, the Arabian Gulf is the most vulnerable to pollution because it is connected to the Gulf of Oman only through the narrow Strait of Hormuz and receives very little regulation from the ocean.

(a) Thermal Pollution

The average depth of the Arabian Gulf as a whole is about 34 meters. However, in most of the inshore areas, the average depth is 10 meters for many kilometers off the coast. These shallow waters can get warm very fast. The inshore water surface temperature ranges from 10°C in winter to 36°C in summer along the Saudi Arabian coast. The offshore temperature ranges from 18°C in winter, in the water off the Kuwait coast, to 34°C in summer, in the water off Qatar and the United Arab Emirates. The average difference between surface and bottom temperatures is about 10°C in summer. (Reference 2, p.2).

The industrial water cooling exchange system discharges a large quantity of warm water into the Arabian Gulf during the summer months. The discharged warm water lowers the purging capacity of the Gulf water with regard to industrial and urban sewage. It also decreases the oxygen level in the water, and this can create considerable stress to marine life. It causes greater stress to pelagic species than to the demersal species because the variations in temperature are greater near the surface than near the bottom.

(b) Salinity of the Arabian Gulf

Evaporation in the Arabian Gulf far exceeds precipitation and runoff from small streams. Since the Arabian Gulf water gets very little regulation from the adjacent ocean, water salinity is high. Surface salinity averages 37 to 40 parts of salt per thousand in the central part of the Arabian Gulf, and 40 to 50 parts per thousand in the shallow areas of the United Arab Emirates.[6] This high salinity causes heavy stress on marine life and decreases the capacity of the water to purge itself of industrial and urban waste.

Owing to the industrialization of the coastal areas around the Arabian Gulf, the demand for fresh water is increasing at a rapid rate. In 1976, there were already 26 desalination and power plants in the region. (Reference 7). The enormous brine disposal from what is the world's greatest concentration of desalination plants aggravates the situation.

(c) Industrial Waste and Spills and Urban Effluents

Industrial pollution is the leading category of pollution in the

Arabian Gulf. There are hundreds of offshore rigs for exploration and production of petroleum and oil tanker traffic is very dense. In 1976, there were 26 oil loading terminals and some 100 vessels a day entering the Strait of Hormuz. (Reference 7). The danger of oil spills and oil blow-outs from the concentrated drilling, storing, and shipping activities are very real indeed.

In the early stages of rapid development, heavy congestion existed at virtually every port in the Arabian Gulf. It was not unusual for 30 to 40 ships to be waiting to be unloaded. Substantial waste was discharged into the shallow waters while fleets were at anchor for many weeks. Even today the traffic remains heavy, and there are considerable environmental hazards.

Hydrocarbon emissions into the air from refineries, petrochemical plants, and metal industries are quite serious. The airborne particles may be transported to the sea surface by coastal temperature inversion. Gas may stay for a long time because of the stagnant air inversions.

Chemical effluent and organic pollution from industrial complexes, fish packing, and meat packing industries are hazardous to marine life. The typical industrial effluents are compounds of nitrogen, sulphur, and carbon. The effluents include oil, phenols, cyanide, and heavy metals.

The construction activities and land-fills around the coastal area are also destructive of marine life. Rapid development requires large quantities of material along the coast for urban, highway, and port construction. Coral reefs are sometimes excavated for construction material. All of this disturbs the marine ecology. Urbanization also brings in another source of pollution -- urban sewage.

(d) Summary and Concluding Observation

The environmental problems in the Arabian Gulf are essentially a by-product of economic development in the region. The level of industrial pollution is becoming a problem but has not yet reached a critical level. Since a clean environment is a common-property resource -- something shared by all countries of the region -- environmental management requires a close co-ordination of activities among various governments.

There are already some joint efforts in environmental management, such as joint studies and research programs among the GCC countries. There are also efforts to reduce urban and industrial effluent in the region. Policies to continue and strengthen these efforts would seem to be highly desirable.

6-5. THE UTILIZATION OF BY-CATCH

(a) General

The term "by-catch" refers to the incidental catches of non-target species that are subsequently disposed of. There is a substantial amount of by-catch discarded in the GCC region each year. However, the volume varies with country, seasonal weather, location, and the state of the fisheries. Table 6-17 presents some rough estimates of the quantity of by-catch discarded in 1979. The total by-catch in the GCC region as a whole in 1979 is estimated at 8,800 metric tons, or approximately 12 percent of the overall catch. Over 70 percent of the by-catch was caught by commercial fishing trawlers.

The revival of commercial shrimp trawling has drastically increased the total volume of by-catch. The by-catch rate for shrimping in the Arabian Gulf is between 50 and 80 percent. The future development of commercial fish trawling will increase further the quantity of by-catch.

The characteristics of the by-catch of each country in the region are briefly described as follows (based on data in Reference 8):

BAHRAIN: The by-catch from commercial fish trawling is generally between 30 and 50 percent. The predominant by-catch species are small emperors (lethrinidae), goat fish (upeneus sp.), lizzard fish (synodontidae), and triggerfish (abalistes sp.). There are several species presently discarded that have some value abroad. These include cuttlefish (sepia sp.), snappers (lutjanus argentimaculatus), flatfish (pleuronectiformes), sharks, and rays.

KUWAIT: The commercial shrimping by-catch rate is about 80 percent, while the commercial demersal fishing by-catch rate is about 50 percent. Unlike other GCC countries, there is a local market in Kuwait for catfish (arius), flatfish (pleuronectiformes), lizzard fish, spade fish (drepane longimana), sicklefish (drepane punctata), and terapons (terapon puta). Among the by-catch species, there is a large proportion with some commercial value abroad, such as sharks and rays.

The processing and fish meal plants of Kuwait were underutilized in 1979. Owing to its large proportion and volume of by-catch, the country has the potential to exploit the market possibilities for by-catch in the future.

OMAN: The most common by-catch species are catfish, moray eels (muranesocidae), parrot fish (collydon sp.), spade fish, lizzard fish, and dog fish (mustelus canis). Very few species in the Omani by-catch are truly inedible trash fish. Approximately 80 percent of by-catch can be used either for fillet preparation or mince production. Some of the by-catch is sold to Korea (mainly dog fish), Jordan (mainly spade fish), Saudi Arabia (mainly trevallies (carangidae)), and Kuwait.

QATAR: The by-catch rate from commercial trawling activity ranges from as low as 20 to as high as 80 percent of the total catch. The predominant by-catch species include small shoaling fish, catfish, sharks, and rays. Other discarded species that are of commercial value elsewhere in the GCC region and Europe are mullets (surnullidae) and some small pelagic species.

SAUDI ARABIA: The by-catch rate is extremely low in Saudi Arabia, and the small quantity of by-catch is not considered a problem. This is partly because the fish landed are mainly from the highly selective artisanal sector (based on 1979 data), and partly because Saudi Arabia has a local market demand for the small trevallies, emperors, red snappers, and grey mullets (mugilidae) which are discarded elsewhere in the GCC region.

UNITED ARAB EMIRATES: The bulk of the by-catch in the UAE comes from the artisanal fishing sector. That is to say, it comes mainly from the 25 fishing villages scattered along the coast. Because of the wide dispersion of fishing villages and the great variety of by-catch composition, commercial by-catch utilization would be difficult.

(b) The Causes of By-catch

There are several reasons for the substantial quantity of by-catch caught in the GCC region:

Inedible species

A small proportion of by-catch is truly inedible because of toxicity. The toxic species are putterfish (tetraodontidae), scorpion fish (scorpionidae), and anthias species. Several species have flesh of poor palatability. These include therapons, remoras, mojaras (gerres oyena), sharks, rays, and ponyfish (leiognathus sp.). Other species are discarded because the flesh is difficult to extract. These include lizzardfish, cardinal fish (apogon unionatus), moonfish (menidae), butterfly fish (chaetodontidae), and some of the small pelagic species.

Traditional selective eating habits

The indigenous population traditionally consumes only a very selective range of fish types. Social or cultural constraints limit the consumption of certain species (e.g., catfish). Some species are believed to be inedible because of their unattractive appearance, such as toadfish (batrachoididae), flatheads, dolphinfish (coryphaena hippurus), goatfish, Indian halibut (psettodes erumei), and needlefish.

The cost-benefit dimension of by-catch utilization

The market value of by-catch products is generally low. However, the costs of producing by-catch products are high, for the following reasons: (1) The development of the oil and oil-related sectors have driven up wage rates and made the labour required for the production of by-catch products very expensive. (2) The costs of transportation and storage associated with getting the by-catch from different fishing villages to central processing plants are quite high. (3) The quantity of by-catch landing often fluctuates widely. This makes fishmeal and canning operations difficult since they usually require a consistent supply of fish to achieve economies of scale.

(c) The Potential for By-catch Utilization in the Future

The development of the by-catch industry in the future is a promising possibility. This is based on the following prospects:

(1) The supply side: The future development of commercial fish trawling, especially in the Gulf of Oman and the Arabian Sea, will ensure a large volume and a steadier supply of by-catch. The fish processing, fishmeal, and canning industries all exhibit increasing economies of scale. A steadier supply will ensure higher capacity utilization and a more feasible industrial operation.

(2) The demand side: Fish consumption in the GCC region is on the rise. Consumer education to accept other non-traditional species can decrease not only the volume of fish imported, but also the volume of by-catch that is

discarded. The prospects for agricultural development in the region imply an increased demand for by-catch as fertilizer. A large quantity of sun-dried fish is used already as soil conditioner in parts of Oman and the United Arab Emirates, and this is a good outlet for artisanal by-catch, especially when the collection and transportation of by-catch from the scattered villages are difficult. Production of livestock and poultry has been increasing recently too. The feedstuffs are mainly imported at present, and there exists, therefore, a potential demand for domestic by-catch as animal feed. The fish silage technique is an attractive option for by-catch utilization as animal feed. Production could be undertaken based on both commercial and artisanal by-catch.

(d) Summary and Concluding Observation

At present, a substantial amount of by-catch is discarded in the GCC region. Since the region is a net importer of food fish, animal feed, and fertilizer, by-catch utilization is a promising possibility in the context of a policy of substituting domestic products for imports. If one objective of the GCC region is to diversify its economy and to avoid overdependence upon imported food supply, the utilization of by-catch would seem to be a matter deserving of some priority.

6-6. ASPECTS OF FISHERY RESOURCE DEVELOPMENT

(a) General

The demand for food fish in the GCC region in the year 2000 is predicted to be 190 thousand tons. (Reference 9). If the demand cannot be met fully from domestic production it will obviously necessitate imports. The development of the fisheries, therefore, would represent an element in a policy to restrict dependence on imports generally, to achieve economic diversification, and to be as self-sufficient as possible in food supply.

As data presented in Section 6-3 indicate, the potential yields of the surrounding waters are very high. Self-sufficiency in food fish by the year 2000 appears feasible.

It is useful to classify development strategies into two categories: those that are local in nature and those that are regional. We discuss each of these categories separately.

(b) Local Development Strategies

The fisheries industry in the region is characterized by a larger traditional (artisanal) sector and a smaller commercial (highly mechanized) sector. In some degree, therefore, a "dualistic economy" exists. Development strategies should take this into account.

(1) Development of the artisanal fishing sector: At present, this sector provides over 90 percent of the total fish landed. Traditionally, small-scale artisanal fishing has been a way of life for a great part of the fishing population. Therefore, the development of this sector should not be looked at in isolation but should be considered in the broader context of rural development. A comprehensive consideration of social and cultural, as well as economic, factors is called for. A credit-loan scheme designed specifically for artisanal fishermen might help to stabilize their incomes and enhance their quality of life. Borrowing through the private financial market is, in general, difficult for the artisanal fishermen. The existing credit-loan institutions in the GCC countries might be adapted in order to give more consideration to the requirements of these fishermen. A proper public infrastructure would also be of aid to the artisanal sector. It seems essential to establish Fisheries Development Centres in rural fishing communities where facilities such as market services, fish-landing sites, manpower training services, roads, etc., are required. The current market

facilities for the artisanal sector are quite inadequate. The planning of these Fisheries Development Centres was initiated at a regional meeting held in Doha in June, 1979. (Reference 10).

(2) Development of the commercial fishing sector: Commercial fish trawling is a highly mechanized and capital-intensive operation. This seems to fit the current economic situation of the region, which is characterized by a shortage of labour. The mechanized fleets can harvest the sea on a large scale. The development of commercial trawling is especially feasible for the Gulf of Oman and the Arabian Sea. Almost all commercial fish trawling in the region is carried out jointly by public and private enterprises. There are also joint ventures among countries in the region (such as the Arab Fishing Company) and with foreign fishing companies (such as Omani/Japanese and Omani/Korean joint ventures). With proper management, joint ventures with foreign fishing companies can assist the training of local manpower and the dissemination of foreign fishing technology.

(3) Development of local markets for other types of fish: Fish consumption habits in the region are very traditional and deep-rooted. Efforts to change consumer attitudes and to introduce new species to the diet through advertising and demonstrations may be helpful in this regard. Such efforts might serve to reduce the quantity of by-catch discarded by creating some demand for it among the domestic population.

(4) Training and education of fishermen: One of the major obstacles to the development of artisanal fisheries is the requirement for training and education of fishermen. The current fishing methods are mostly techniques that have been handed down from generation to generation. The gap between traditional and modern fishing techniques widens as time passes.

(c) Regional Co-operative Strategies for Development

Proper management of fishery resources may involve shared benefits and responsibilities for the countries of the region. The central problem here is the conflict between individual (or local) interests and collective (or regional) interests. Areas for co-operation include the following:

(1) Conservation of marine resources: The landings of shrimp in the Arabian Gulf have been declining for many years, largely, it would appear, as the result of a conflict between individual and collective interests. Enterprises separately pursue a goal of maximizing their catch. In an open-access, free-for-all shrimp fishery, competing fishermen try to catch all the shrimp available to them, regardless of consequences. Unless they are checked, the consequence may be an overall reduction, if not extinction, of the resource base. To avoid this, access to shrimping will have to be restricted, and this will require continued co-operative efforts among the GCC countries. Around 1981, individual countries in the GCC region imposed closed-season regulation for shrimping, and there are already some signs that the shrimp fishery is reviving.

(2) Pollution control: Pollution in the Arabian Gulf is also a shared problem. Effluent from individual industries is discharged into the Gulf, regardless of the overall consequences. To protect the natural environment and the marine life of the Arabian Gulf, pollution control must be enforced by all of the countries concerned. Co-operative efforts are again required.

(3) Fisheries research: Research on the improvement of traditional fishing methods and the modification of western-type boats and nets to suit local conditions are important for the development of the industry. A good set of fisheries statistics is also important for planning. At present,

fisheries research and the collection of fisheries data are quite inadequate. These are also areas that require co-operation among GCC countries so that duplication can be avoided and research costs shared.

FOOTNOTES FOR CHAPTER 6

1. Data were kindly provided by Dr. A.E. Imam, Director of the Department of Fisheries for the State of Qatar.
2. The definition and calculation of "potential yield" are described in Reference 3, pp.120-125.
3. These figures in this paragraph are based on rough estimates provided by the FAO/UNDP in Reference 6. Note that most of the kingfish are caught in the fishing centre of Jizan.
4. The data in this paragraph are taken from Reference 6.
5. This calculation is based on the minimum values of the estimated potential yields. The yield of small pelagic species is proportionately very large, and this shifts the average towards these species. To compensate for this, the weight of the small pelagic species is reduced by half, giving an overall ratio of potential yield to current output of 4.7. A "safety factor" of 80 percent is then applied to obtain a final ratio of about 4.
6. See Reference 2, pp.2-6. Note that the salinity level in the Gulf of Oman and the Arabian Sea is about 34-35 parts per thousand.

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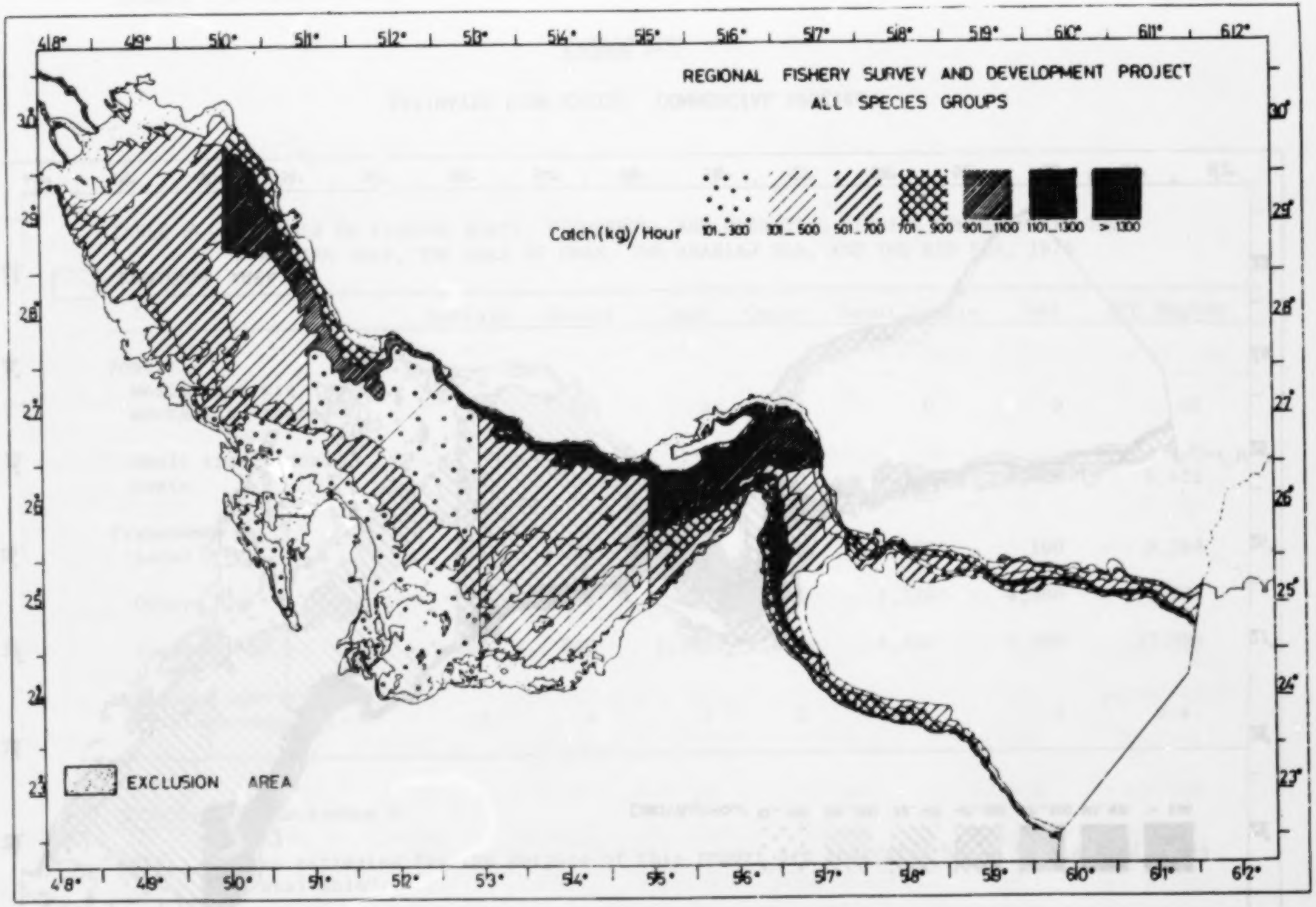
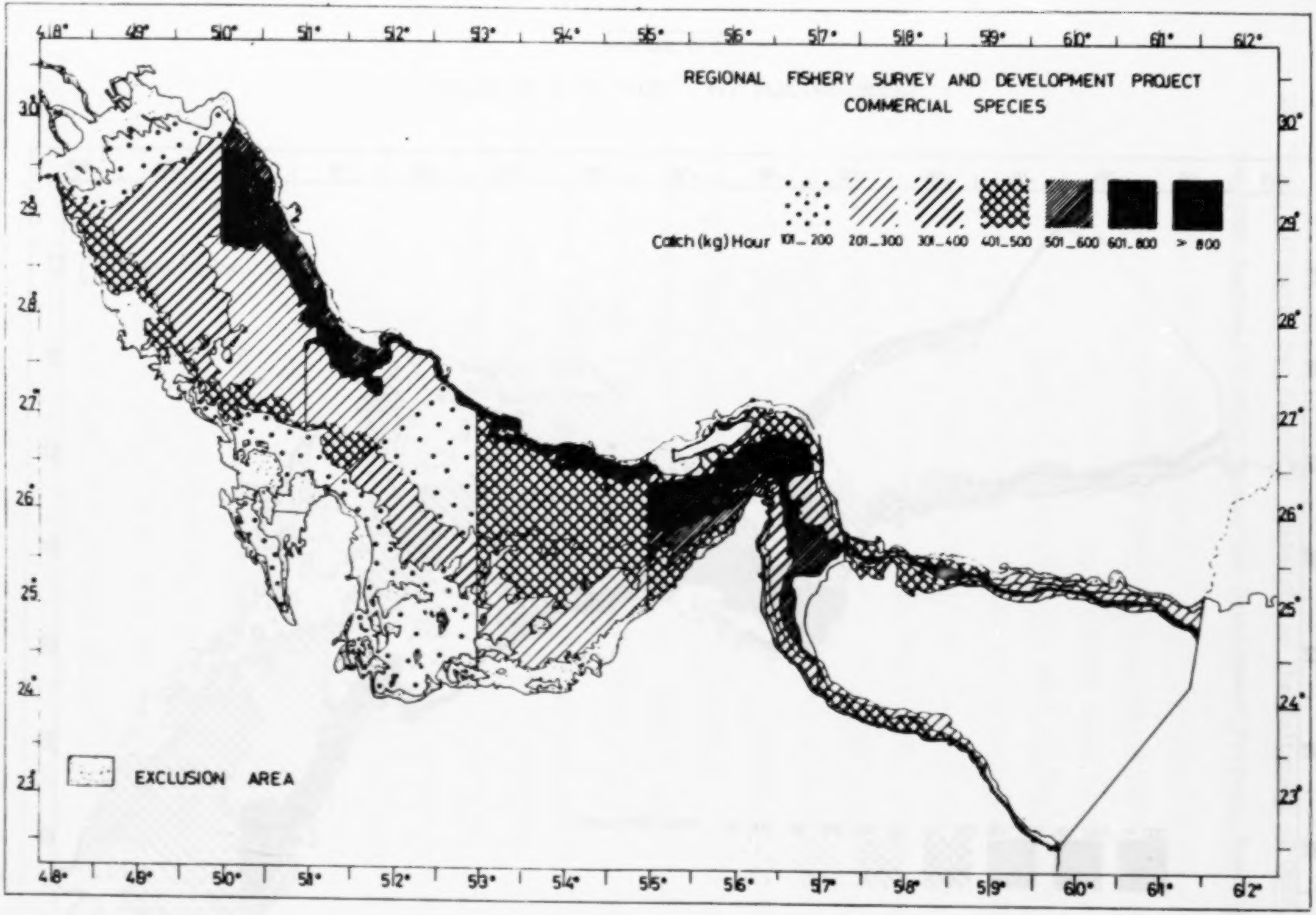

REGIONAL FISHERY SURVEY AND DEVELOPMENT PROJECT
ALL SPECIES GROUPS
Catch(kg)/Hour
101_300
301_500
501_700
701_900
901_1100
1101_1300
> 1300
EXCLUSION AREA
48°
49°
50°
51°
52°
53°
54°
55°
56°
57°
58°
59°
60°
61°
62°
23°
24°
25°
26°
27°
28°
29°
30°

ESTIMATED FISH CATCH: ALL SPECIES GROUPS

FIGURE 6-1

SOURCE: See Reference 3.


REGIONAL FISHERY SURVEY AND DEVELOPMENT PROJECT
COMMERCIAL SPECIES
Catch (kg) Hour
101_200
201_300
301_400
401_500
501_600
601_800
> 800
EXCLUSION AREA
48°
49°
50°
51°
52°
53°
54°
55°
56°
57°
58°
59°
60°
61°
62°
30°
29°
28°
27°
26°
25°
24°
23°

ESTIMATED FISH CATCH: COMMERCIAL SPECIES

FIGURE 6-2

SOURCE: See Reference 3.

TABLE 6-1: NUMBER OF FISHING BOATS, FISHERMEN, AND OPERATING FISHING COMPANIES IN THE ARABIAN GULF, THE GULF OF OMAN, THE ARABIAN SEA, AND THE RED SEA, 1978

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Boats:							
Medium and big mechanized boats	19	35	4	7	0	0	65
Small traditional boats	100	500	2,500	150	1,400	1,025	5,675
Fishermen:							
Local	225	84	5,700	75	3,080*	100	9,264
Others	25	756	300	1,425	1,320*	4,900	8,726
Total	250	840	6,000	1,500	4,400	5,000	17,990
Number of operating fishing companies	2	1	2	2	n.a.	2	n.a.

SOURCE: See Reference 9.

NOTE: Figures estimated for the purpose of this report are indicated by an *; n.a. indicates "not available".

TABLE 6-2: NOMINAL CATCHES OF FISH, CRUSTACEANS, MOLLUSCS, ETC., IN THE GCC REGION (METRIC TONS)

Years	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1972	1,500[2]	3,900[2]	180,000[2]	2,000	23,800	43,000	254,200
1973	1,500[2]	5,200	180,000[2]	2,200	26,400	43,000	258,300
1974	1,500[2]	4,711	180,000[2]	2,347[2]	23,600	68,000	280,158
1975	1,500[2]	5,145	198,850	2,289[2]	23,000	64,000	298,794
1976	4,084	4,691	197,984	2,700[2]	23,300	64,431	297,190
1977	4,837	5,252	70,000[2]	2,733[2]	23,400[2]	64,400	170,622
1978	4,000	6,413	70,000[2]	2,733[2]	26,550	64,400	174,096
1979	4,313	5,000	70,000[2]	2,733[2]	26,160	64,400	172,606
1980	5,500	5,791	70,000[2]	1,736[1]	26,425	64,400	174,849
1981	6,098[3]	n.a.	n.a.	2,273[1]	n.a.	n.a.	n.a.

SOURCE: Except as otherwise noted, data are from the Food and Agriculture Organization of the United Nations (FAO) Yearbook of Fishery Statistics, 1975 to 1980.

1. Data provided by Department of Fisheries, Ministry of Industry and Agriculture, Qatar.

2. FAO estimates.

3. Data from Annual Statistics Report, 1981, Fisheries Statistical Service, Ministry of Commerce and Agriculture, Bahrain.

NOTE: n.a. indicates "not available."

TABLE 6-3: NOMINAL CATCHES OF BAHRAIN, BY SPECIES, 1972-1980 (METRIC TONS)

Species	1972	1973	1974	1975	1976	1977	1978	1979	1980
Grouper (*epinephelus* species)	...	...	...	...	533	631	522	548	603
Seabasses, seaperches (*serranidae*)	...	...	...	...	768	909	751	755	1,170
Snappers (*lutjanus* sp.)	...	...	...	...	269	319	264	251	330
Grunters (grunts) (*pomadasyidae*)	...	...	...	...	90	106	88	93	111
Porgies, seabreams (*sparidae*)	...	...	...	...	54	64	53	52	58
Goatfishes (*upeneus* sp.)	...	...	...	...	58	68	56	52	78
Rabbitfishes (spinefeet) (*siganus* sp.)	...	...	...	...	493	584	483	454	719
Barracudas (*sphyraena* sp.)	...	...	...	...	76	90	75	72	122
Jacks, trevallies (*caranx* sp.)	...	...	...	...	345	408	337	444	382
Tuna-like fishes (*scombroidei*)	...	...	...	...	2	...	...	3	3
Mackerel-like fishes (*scombroidei*)	...	...	...	...	100	118	98	169	268
Marine fish	800[2]	800[2]	800[2]	800[2]	819	972	803	985	887
Marine crabs	...	...	...	...	25	30	25	23	41
Slipper lobsters (*scyllaridae*)	0	0	0	0	0	0	0	2	4
Shrimps and pawns (*natantia*)	700[2]	700[2]	700[2]	700[2]	444	526	435	223[3]	746[3]
Cuttlefishes (*sepia, sepiola* sp.)	...	...	...	...	10	12	10	9	25
Total	1,500[2]	1,500[2]	1,500[2]	1,500[2]	4,086	4,837	4,000	4,135	5,547

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: ... indicates "negligible".

TABLE 6-4: IMPORTS AND EXPORTS OF THE SEVEN FISHERY COMMODITY GROUPS OF BAHRAIN, 1970-1980

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(1)	Fish, fresh, chilled or frozen											
	Imports MT	...	100	0	0	0	32	68	326	90	131	131
	(1,000 US$)	(...)	(55)	(65)	(3)	(48)	(104)	(179)	(475)	(397)	(495)	(495)^{2}
	Exports MT	300^{2}	0	500	0	0	133	0	0	0	0	0
	(1,000 US$)	(380)	(17)	(481)	(0)	(205)	(235)	(0)	(0)	(0)	(0)	(0)
(2)	Fish, dried, salted or smoked											
	Imports MT	...	...	700	600	1,100	455	292	324	353	42	42^{2}
	(1,000 US$)	(...)	(10)	(65)	(58)	(124)	(63)	(94)	(63)	(255)	(68)	(68)^{2}
	Exports MT	600^{2}	100	600	300	600	266	152	220	206	0	0
	(1,000 US$)	(151)^{2}	(6)	(162)	(30)	(63)	(255)	(13)	(63)	(160)	(0)	(0)
(3)	Crustaceans and molluscs, fresh, frozen, dried, salted, etc.											
	Imports MT	...	...	...	0	...	9	35	32	36	17	17^{2}
	(1,000 US$)	(...)	(8)	(6)	(0)	(35)	(28)	(131)	(106)	(103)	(100)	(100)^{2}
	Exports MT	500^{2}	700	200	...	300	318	898	405	32	0	0
	(1,000 US$)	(940)^{2}	(914)	(288)	(30)	(604)	(986)	(2,086)	(2,058)	(59)	(0)	(0)
(4)	Fish products and preparations, whether or not in airtight containers											
	Imports MT	...	200	100	...	300	207	308	635	179	175	175^{2}
	(1,000 US$)	(...)	(116)	(97)	(15)	(414)	(323)	(442)	(943)	(544)	(385)	(385)^{2}
	Exports MT	...	...	...	...	100	171	201	144	6	0	0
	(1,000 US$)	(...)	(8)	(2)	(3)	(96)	(549)	(154)	(159)	(10)	(0)	(0)
(5)	Crustacean and mollusc products and preparation whether or not in airtight containers											
	Imports MT	0	0	0	0	0	0	0	0	0	0	0
	(1,000 US$)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	Exports MT	0	0	0	0	0	0	0	0	0	0	0
	(1,000 US$)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

(Continued...)

TABLE 6-4: (Continued)

			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(6)	Oil and fats, crude or refined of aquatic animal origin												
	Imports	MT	...	100	100	0	...	0	6	11	6	31	31[2]
		(1,000 US$)	(...)	(15)	(6)	(0)	(13)	(0)	(13)	(10)	(10)	(18)	(18)[2]
	Exports	MT			0	...	0	...	2	0	1	0	0
		(1,000 US$)	(2)[2]	(2)	(0)	(...)	(0)	(...)	(...)	(0)	(3)	(0)	(0)
(7)	Meals, solubles and similar animal feedingstuffs of aquatic animal or origin												
	Imports	MT	0	0	0	0	0	0	0	0	0	0	0
		(1,000 US$)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	Exports	MT	0	0	0	0	0	0	0	0	0	0	0
		(1,000 US$)	(0)	(0) 0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: MT stands for metric tons; ... indicates "negligible".

TABLE 6-5: NOMINAL CATCHES OF KUWAIT, BY SPECIES, 1972-1980 (METRIC TONS)

Species	1972	1973	1974	1975	1976	1977	1978	1979	1980
Shad (hilsa ilisha)	300^2	300	347	385	218	292	235	164	209
Demersal percomorphs (perciforms)	100^2	100	71	83	91	74	130	250	189
Groupers (epinephelus sp.)	300^2	300	469	398	304	331	373	613	872
Snappers (lutjanus sp.)	200^2	200	217	172	198	209	237	146	178
Grunts (grunters) (pomadasyidae)	200^2	200	113	280	341	378	372	448	527
Croakers, drums (sciaenidae)	200^2	200	180	238	243	366	441	259	233
Mullet (mugil cephalus)	0	0	136	165	141	159	210	76	70
Fourfinger threadfin (eleutheronema tetradactylum)	...	...	...	55	58	58	...	65	98
Carangids (carangidae)	...	...	...	178	204	234	235	83	100
Silver pomfret (pampus argenteus)	400^2	500	1,049	1,101	610	575	664	1,591	1,624
Butterfishes (stromateidae)	...	...	...	162	126	154	158	33	22
Narrow-barred king mackerel (scomberomorus commerson)	...	0	87	135	144	148	161	33	37
Marine fishes	$1,000^2$	1,200	1,171	832	1,160	1,419	2,318	640	721
Shrimps and pawns (natantia)	$1,000^2$	2,000	516	473	562	397	385	447	573
Total	$3,900^2$	5,200	4,711	5,145	4,691	5,252	6,413	5,000	5,791

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: ... indicates "negligible".

TABLE 6-6: IMPORTS AND EXPORTS OF THE SEVEN FISHERY COMMODITY GROUPS OF KUWAIT, 1970-1980

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(1) Fish, fresh, chilled or frozen											
Imports MT	100	100	400	100	100	200	1,557	2,977	3,724	3,724[2]	3,724[2]
(1,000 US$)	(87)	(90)	(176)	(115)	(140)	(290)	(2,131)	(4,038)	(5,210)	(5,187)[2]	(5,187)[2]
Exports MT	...	200	300	100	...	...	59	495	1,240	1,240[2]	1,240[2]
(1,000 US$)	(11)	(64)	(116)	(20)	(27)	(7)	(92)	(712)	(1,880)	(1,882)[2]	(1,882)[2]
(2) Fish, dried, salted or smoked											
Imports MT	...	100	100	100	...	...	50	173	71	71[2]	71[2]
(1,000 US$)	(14)	(39)	(43)	(64)	(34)	(65)	(99)	(405)	(175)	(174)[2]	(174)[2]
Exports MT	0	0	0	...	0	0	4	46	9	9[2]	9[2]
(1,000 US$)	(0)	(0)	(0)	(7)	(0)	(0)	(3)	(94)	(33)	(33)[2]	(33)[2]
(3) Crustaceans and molluscs, fresh, frozen, dried and salted											
Imports MT	200	100	200	100	200	200	83	126	79	79[2]	79[2]
(1,000 US$)	(112)	(87)	(103)	(51)	(338)	(431)	(161)	(282)	(266)	(265)[2]	(265)[2]
Exports MT	1,800	2,800	2,100	4,900	1,300	1,300	686	1,077	570	570[2]	570[2]
(1,000 US$)	(2,668)	(1,865)	(1,651)	(8,784)	(4,942)	(5,193)	(2,483)	(5,448)	(2,788)	(2,776)[2]	(2,776)[2]
(4) Fish products and preparations, whether or not in airtight containers											
Imports MT	1,800	2,100	1,200	1,400	1,800	1,300	1,863	3,633	1,380	1,380[2]	1,380[2]
(1,000 US$)	(1,277)	(1,450)	(973)	(1,345)	(2,227)	(1,917)	(2,421)	(6,456)	(2,985)	(2,972)[2]	(2,972)[2]
Exports MT	600	500	300	700	400	200	865	600	420	420[2]	420[2]
(1,000 US$)	(199)	(199)	(185)	(508)	(362)	(172)	(859)	(810)	(582)	(580)[2]	(580)[2]

(Continued...)

TABLE 6-6: (Continued)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(5) Crustacean and mollusc products and preparations, whether or not in airtight containers											
Imports MT	0	0	0	0	0	0	0	0	0	0	0
(1,000 US$)											
Exports MT	0	0	0	0	0	0	0	0	0	0	0
(1,000 US$)											
(6) Oil and fats, crude or refined of aquatic animal origin											
Imports MT	400	100	100	...	100	300	97	17	49	49[2]	49[2]
(1,000 US$)	(75)	(14)	(18)	(3)	(58)	(145)	(38)	(10)	(15)	(14)[2]	(14)[2]
Exports MT	100	...	...	...	0	100	21	30	0	0	0
(1,000 US$)	(20)	(6)	(3)	(7)	(0)	(17)	(3)	(7)	(0)	(0)	(0)
(7) Meals, solubles and similar animal feedingstuffs of aquatic animal origin											
Imports MT	0	0	0	0	0	0	0	0	0	0	0
(1,000 US$)											
Exports MT	0	0	0	0	0	0	0	0	0	0	0
(1,000 US$)											

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: MT stands for metric tons; ... indicates "negligible".

TABLE 6-7: NOMINAL CATCHES OF OMAN, BY SPECIES, 1972-1980 (METRIC TONS)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Demersal species	n.a.	n.a.	n.a.	9,600	9,201	8,500	8,500[2]	8,500[2]	8,500[2]
Pelagic species	n.a.	n.a.	n.a.	189,250	188,783	61,500	61,500[2]	61,500[2]	61,500[2]
Total	180,000[2]	180,000[2]	180,000[2]	198,850	197,984	70,000	70,000[2]	70,000[2]	70,000[2]

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: n.a. indicates "not available".

TABLE 6-8: NOMINAL CATCHES OF QATAR, BY SPECIES, 1972-1980 (METRIC TONS)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Marine fishes	1,500[2]	1,500[2]	1,800[2]	1,800[2]	1,800[2]	1,800[2]	1,800[2]	1,800[2]	1,800[2]
Shrimps and pawns (natantia)	500[2]	700	547	498	900	933	933[2]	933[2]	933[2]
Total	2,000[2]	2,200[2]	2,347[2]	2,289[2]	2,733[2]	2,733[2]	2,733[2]	2,733[2]	2,733[2]

SOURCE: See Table 6-2 for basic source and source notes.

TABLE 6-9: NOMINAL CATCHES OF SAUDI ARABIA, BY SPECIES, 1972-1980 (METRIC TONS)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Marine fish	18,700	20,300	20,300	20,000	18,500	16,800	16,200	16,200	16,300
Shrimps and pawns (natantia)	5,100	6,100	3,300	3,000	4,800	1,600	1,600	1,700	1,650
Crustaceans (crustacea)	0	0	0	...	...	5,000[2]	8,700	8,200	8,400
Molluscs (mollusca)	0	0	0	0	0	0	50	60	75
Total	23,800	26,400	23,600	23,000	23,300	23,400	26,550	26,160	26,425

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: ... indicates "negligible".

TABLE 6-10: IMPORTS AND EXPORTS OF THE SEVEN FISHERY COMMODITY GROUPS OF SAUDI ARABIA, 1970-1980

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(1)	Fish, fresh, chilled or frozen											
	Imports MT	...	...	...	...	100	296	570	2,677	6,093	11,638	15,614
	(1,000 US$)	(46)	(46)[2]	(59)	(69)	(128)	(420)	(643)	(3,338)	(8,212)	(15,561)	(24,392)
	Exports MT	100	100[2]	300	1,800	...	1	...	...	16	...	146
	(1,000 US$)	(43)	(43)[2]	(170)	(527)	(22)	(1)	(...)	(...)	(37)	(...)	(155)
(2)	Fish, dried, salted or smoked											
	Imports MT	100	100[2]	...	100	100	276	538	561	881	1,353	1,732
	(1,000 US$)	(36)	(36)[2]	(8)	(44)	(117)	(196)	(494)	(778)	(1,458)	(2,997)	(4,678)
	Exports MT	...	...	0	...	...	74	...	...	...	...	...
	(1,000 US$)	(4)	(4)[2]	(0)	(1)	(...)	(13)	(...)	(...)	(...)	(...)	(...)
(3)	Crustaceans and molluscs fresh, frozen, dried, salted, etc.											
	Imports MT	...	...	100	...	...	101	298	155	186	401	733
	(1,000 US$)	(17)	(17)	(29)	(34)	(186)	(198)	(779)	(318)	(606)	(1,793)	(3,909)
	Exports MT	300	300[2]	...	100	...	49	...	...	...	...	...
	(1,000 US$)	(112)	(112)[2]	(...)	(92)	(4)	(5)	(...)	(...)	(...)	(...)	(...)
(4)	Fish products and preparations, whether or not in airtight containers											
	Imports MT	1,200	1,200[2]	1,500	5,100	4,000	4,990	7,788	12,827	11,047	14,774	19,873
	(1,000 US$)	(636)	(636)[2]	(1,133)	(3,758)	(4,574)	(5,382)	(7,568)	(19,190)	(18,516)	(23,499)	(36,623)
	Exports MT	...	...	...	100	...	681	1,263	1,361	1,235	1,241	3,867
	(1,000 US$)	(5)	(5)	(10)	(67)	(221)	(404)	(1,256)	(1,447)	(1,740)	(1,763)	(3,096)
(5)	Crustacean and mollusc products and preparations, whether or not in airtight containers											
	Imports MT	...	...[2]	100	...	200	40	71	224	415	728	772
	(1,000 US$)	(6)	(6)[2]	(44)	(17)	(175)	(69)	(139)	(580)	(1,175)	(2,099)	(2,605)
	Exports MT	0	0	...	...	100	...	...	...	...	...	9
	(1,000 US$)	(0)	(0)	[illegible]	[illegible]	(70)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(Continued...)

TABLE 6-10: (Continued...)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
(6) Oils and fats, crude or refined, of aquatic animal origin											
Imports MT	...	...	...	300	100	0	...	...	105	...	...
(1,000 US$)	(1)	(1)[2]	(2)	(51)	(60)	(0)	(...)	(...)	(120)	(...)	(...)
Exports MT											
(1,000 US$)											
(7) Meals, solubles and similar animal feedingstuffs, of aquatic animal origin											
Imports MT	...	...	...	...	...	97	42	...	125	...	74
(1,000 US$)	(...)	(...)	(...)	(...)	(8)	(17)	(55)	(...)	(71)	(...)	(35)
Exports MT	...	...	...	...	...	1	...	...	...	...	...
(1,000 US$)	(...)	(...)	(...)	(...)	(...)	(1)	(...)	(...)	(...)	(...)	(...)

SOURCE: See Table 6-2 for basic source and source notes.

NOTE: MT stands for metric tons; ... indicates "negligible".

TABLE 6-11: NOMINAL CATCHES OF THE UAE, 1972-1980 (METRIC TONS)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Marine fishes	43,000	43,000	68,000	68,000	64,431	64,400	64,400	64,400	64,400

SOURCE: See Table 6-2.

TABLE 6-12: SPECIES COMPOSITION IN THE ARABIAN GULF

Species group		% of total
Commercial group (Marketable in the GCC region)		62.6
1). Jacks, trevallies, scads and horse mackerels	(carandidae)	16.7
2). Goatfishes	(mullidae)	9.4
3). Driftfishes	(ariommidae)	6.8
4). Threadfin	(nemipteridae)	5.3
5). Emperor	(lethrinidae)	4.1
6). Requiem sharks	(carcharhinidae)	3.4
7). Sardines	(clupeidae)	3.2
8). Grunts	(pomadasyidae)	2.8
9). Snappers	(lutjanidae)	2.7
10). Groupers	(serranidae)	1.6
11). Shrimps and lobsters	(crustacea)	.5
12). Others		6.1
Non-commercial group (Not marketable in the GCC region)		37.4
1). Ponyfishes	(leiognathidae)	12.7
2). Lizzardfish	(synodontidae)	7.3
3). Catfish	(ariidae)	4.5
4). Sting rays	(dasyatidae)	3.0
5). Others		9.9

SOURCE: See Reference 3, p.14.

TABLE 6-13: ESTIMATES OF THE GENERAL ANNUAL LANDING AND POTENTIAL YIELDS OF THE ARABIAN GULF (METRIC TONS)

Species	Annual catch	Annual potential yields
(1) Demersal species (sea-bottom fishes)		
a) commercial	25,000	140,000
b) non-commercial	18,000	100,000
Total demersal	43,000	240,000
(2) Large pelagic species (tuna-like fishes)	10,000	20,000
(3) Small pelagic species (sardine-like fishes)	3,400	360,000
Total	56,400	620,000

SOURCE: See Reference 3, Part 4.

NOTE: Estimates include catches and yields from the Iran and Iraq side of the Arabian Gulf.

TABLE 6-14: NOMINAL CATCH OF SHRIMP (NATANTIAN DECUPODS) IN THE GCC REGION, 1972-1980 (METRIC TONS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
1972	n.a.	1,000	0	500	5,100	...	n.a.
1973	n.a.	2,000	0	700	6,100	...	n.a.
1974	700	516	0	547	3,300	...	5,063
1975	700	473	0	489	3,009	...	4,662
1976	444	562	0	900	4,800	...	6,706
1977	526	397	0	933	1,600	...	3,455
1978	435	385	0	933	1,600	...	3,353
1979	223	447	0	933	1,700	...	3,303
1980	746	573	0	933	1,650	...	3,902
1981	633[3]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

SOURCE: See Table 6-2 for basic source and source notes.

NOTES: n.a. indicates "not available"; ... indicates "negligible".

TABLE 6-15: ANNUAL CATCHES AND POTENTIAL YIELDS OF MARINE RESOURCES IN THE GULF OF OMAN

Species		Percent of total catch	Estimated annual catch (metric tons)	Potential annual yield (metric tons)
(1)	Demersal species			
	a) Commercial	60.0	4,000	16,900-32,000
	Seabreams (argyrops sp.)	2.2	143	400-800
	Threadfin breams (nemipterus sp.)	19.8	1,316	8,800-17,200
	Jacks (carangidae)	11.5	765	2,700-5,100
	Scavengers (lethrinus sp.)	6.4	426	900-1,500
	Grunts (plectorhynchus sp.)	4.5	298	900-1,600
	Cuttlefish (sepia sp.)	.4	28	300-400
	Groupers (epinephelus sp.)	1.5	105	300-400
	Mixed fish	14.8	919	2,800-5,100
	b) Non-commercial	40.0	2,667	8,800-16,600
	Total	100.0	6,667	25,700-48,600
(2)	Small pelagic species	n.a.	2,000	15,000
(3)	Large pelagic species	n.a.	12,000	24,000
(4)	Mesopelagic species	n.a.	0	1.3 million tons
(5)	Lobster	n.a.	n.a.	n.a.

SOURCE: See Reference 12.

NOTE: n.a. indicates "not available".

TABLE 6-16: ANNUAL CATCHES AND POTENTIAL YIELDS OF MARINE RESOURCES IN THE ARABIAN SEA

Species		Percent of total catch	Estimated annual catch (metric tons)	Potential annual yield (metric tons)
(1)	Demersals			
	Catfish (*arius*)	10.2	...	2,650-6,250
	Rays	4.5	...	1,150-3,350
	Seabream (*argyrops* sp.)	26.7	1,789	14,800-28,350
	Scavenger (*lethrinus* sp.)	12.7	837	3,900-7,250
	Trevallies and jacks (*carangidae*)	6.9	442	4,700-9,200
	Slimehead (*hoplostethus*)	4.7	...	2,400-4,900
	Threadfin bream (*nemipterus*)	4.0	...	5,200-10,500
	Ponyfish (*leiognathus*)	3.1	...	3,300-6,500
	Others	10.2	1,580	2,600-4,200
	Total commercial	83.0	4,648	40,700-80,500
	Total non-commercial	17.0	0	8,900-17,700
	Total demersals	100.0	4,648	49,600-98,200
(2)	Small pelagics	n.a.	...	221,000-278,000
(3)	Large pelagics	n.a.	20,000	30,000
(4)	Mesopelagics	n.a.	0	1.7 million tons
(5)	Lobster	n.a.	20-50	50

SOURCE: See Reference 12.

NOTE: n.a. indicates "not available"; ... indicates "negligible".

TABLE 6-17: BY-CATCH LANDINGS IN THE GCC REGION IN 1979 (METRIC TONS)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC Region
Artisanal by-catch	160	220	800	180	300	1,100	2,760
Commercial by-catch	1,400	3,000	1,000	130	0	500	6,030
Total by-catch	1,560	3,220	1,800	310	300	1,600	8,790
Food fish and shrimp landings	4,720	9,800	26,000	1,400	6,000	16,500	64,420
By-catch as % of total landings	25	25	6.5	18	5	9	12

SOURCE: **See Reference 8.**

CHAPTER 7

OIL AND GAS

7-1. INTRODUCTION

The dominance of oil and gas in the economies of the GCC countries is well known. However, a number of considerations arise especially in the context of expected joint economic activity within the GCC region and these merit particular attention.

7-2. OIL

Each of the GCC member states accounts for a substantial share of the world energy supply and the collective share is very large. Although the region has less than one percent of the world's oil wells, it accounted for 42 percent of the world's proven reserves of crude oil in 1980, and about 63 percent of the corresponding OPEC total. A decade earlier, the GCC share of world proven crude oil reserves was only about 18 percent, or some 113 billion barrels. By 1978, a peak year, these reserves had risen to an estimated 276 billion barrels. (See Table 7-1.)

The crude oil production share of the GCC is not as high as its share of proven reserves, but the region is nevertheless the world's largest producer of crude oil. In 1980, the GCC daily production of crude averaged 14.1 million barrels, or about 23.5 percent of the world total and over 52.3 percent of OPEC's total. (See Table 7-2.)[1] The difference between reserve share and production share has its roots in the political decisions of the old oil consortium, but more recently reflects the conservation decisions of the member states. The allocation in the past of low production rates to the Gulf wells by the oil consortium has left the area with a longer production life span than would otherwise have been the case. In 1980, the GCC reserves were equivalent to 53 years of production at the current rate. By comparison, the average production life of the OPEC reserves was 44 years, and of total world reserves only 30 years in 1980.

Saudi Arabia is the principal oil producer in the region and commands the largest reserve pool. In 1980, the Saudi production of 9.9 million barrels per day accounted for over 70 percent of total GCC production, and Saudi proven reserves were 62 percent of the estimated total. The smallest producer is Bahrain and it is also the state with the smallest reserves. Most of Bahrain's crude oil production is diverted to the local refinery. However, in the GCC as a whole, most of the crude oil produced is exported, and the region thus accounts for the major part of world trade in crude oil. In 1979, the GCC region's share of world exports of crude oil was 40 percent; in 1975 the figure had been as high as 48.5 percent. GCC's share of total OPEC exports of crude oil shows a similar trend, having declined from a high of 57.5 percent in 1975 to slightly over 50 percent in 1979.

The large volume of crude oil exports from the GCC region is the result of a number of fundamental factors. First and foremost is the low cost of production and, recently, of transporting GCC crude oil. Most oil wells in the region are large, close to the surface, largely free flowing, optimally penetrated, and close to coastal outlets. Average productivity of oil wells in the region is estimated to be over

400 times the world average (centrally planned economies excluded). Consider, for instance, the highly productive Burgan field in southeast Kuwait which is only 14-20 miles from the Gulf. A network of gathering lines connects all wells in this field to the storage tanks at Al-Ahmadi on a ridge which is 400 feet above sea level, six miles from the Gulf. Pipelines from the storage farms use gravity to feed oil to the terminal at Al-Ahmadi. (Loading by gravity rather than by use of pumps results in substantial cost savings and, at the same time, in faster loading rates.) This case is typical of most oil wells in the region, including Dukhan (Qatar), Zakum (UAE), Ghawar (Saudi Arabia), and others. Additional advantage has been provided by the falling unit costs of transporting oil across the oceans as larger and larger super tankers have been brought into use. This has been particularly important with respect to the US and Japanese markets, where Arabian Gulf oil can be delivered at prices below the corresponding domestic production costs and/or competitors' costs.

Second, GCC crude oil producers are typically believed to be discretionary producers, that is, they can reduce or increase supply without any major consequences for their economies. The GCC member states, with varying degrees of freedom, could open or close the oil tap at government discretion since their production has often been below shut-in capacity and above their foreign exchange requirements. However, there have been two restraining and countervailing forces. Within the range of discretionary oil production, the actual level appears to have depended less on the expected rates of return and differences of risk on recycled assets than on the evaluation of the likely effects that discretionary change might have on the world economy and the world political scene. Furthermore, the large financial surpluses forced on these economies raised their stake in maintaining the value of these assets by avoiding the precipitation of large changes in oil production and/or prices.

Were oil resources everlasting and renewable, the citizens of the GCC would be entitled to a perpetual rent accruing from these resources and economic diversification would not be a critical consideration. But oil supplies are finite and non-renewable. At recent rates of utilization, oil in the GCC will run out in the life time of the present generation (Qatar, Bahrain, Oman), its children (UAE), or its grandchildren (Saudi Arabia and Kuwait). The accumulation of large financial surpluses in the early 1970s preceded any deliberate plan for their domestic absorption or investment abroad. There was no historical experience on which to base predictions of future growth in domestic absorption, and therefore no reason to question the economic rationality of a surplus of the magnitude realized. However, GCC producers are no longer oblivious to the risks of accumulating fixed-income-yielding assets in an inflationary world. They are, therefore no longer satisfied with their role as just the residual suppliers of the world crude oil requirements. Now they are contemplating the creation of an advanced and integrated industrial base and the expansion of their sphere of control over the transportation, refining, processing, and marketing of their oil and its derivatives.

The utilization of oil resources in "down-stream" activities will be considered following our discussion of natural gas as oil and gas are often joint products (associated gas) or joint inputs (in petrochemical processes).

7-3. NATURAL GAS RESOURCES

Underground oil reservoirs contain dissolved natural gases as a result of pressure and heat, and if oil flows to the surface these gases are freed. Associated with each barrel of oil is a certain volume of gases -- about 500 cubic feet, on average, in most GCC member countries. These are known as associated gases and possess characteristics that vary according to the circumstances of the reservoir. To avoid losing these gases, crude oil production is received at separator and cooling units, where the heavier fractions are separated. The remaining lighter gases come out as gas mix, some of which is reinjected into the oil fields for reasons of production; the other part is used locally or flared into the atmosphere.

All of the crude oil producers in the GCC region, by virtue of their oil production, have a potential command over associated gas. The realization of this potential was delayed by a number of factors, most important of which were the low price of oil and the foreign control over oil production. With the rise in oil price and the assumption of control of production and profits following 1973, the proportion of associated gas that is flared declined sharply. As shown in Table 7-4, the proportion of waste in 1971 for the GCC region as a whole (Oman and Bahrain excepted) was 75.6 percent of the region's gross gas production, and the UAE's percentage was as high as 90 percent. By 1980, however, the waste proportion had fallen to 55.9 percent in the region as a whole. Moreover, the high regional percentage is heavily weighted by Saudi Arabia's experience, and Saudi flaring is expected to decline sharply with the completion of the large complexes at Al-Jubail and Yanbu. This will certainly imply a drastic reduction in the percentage waste of gas produced in the GCC region. Kuwait's, Qatar's, and Bahrain's percentages of wasted gas are already quite low.

With the decline in the flaring of gas, gross production figures will reflect more accurately the rates of utilization of reserves. Gross production figures are presented in Table 7-5 for all GCC member states but Oman. The GCC total increased from 59,159 million cubic meters in 1971 to 87,019 in 1980. Saudi production had more than doubled by 1980, whereas Kuwaiti production was less than half its 1971 level. GCC production of associated gas as a percentage of OPEC or world production did not vary much throughout the period 1971-80: in 1971, the GCC production share was 30 percent of OPEC's and in 1980 it was 32.2 percent; similarly, the GCC's share of world total production was 5.0 percent in 1971 and 5.6 percent in 1980.

Another type of natural gas is produced from reservoirs with no crude oil, and its production is easier to control. GCC proven reserves of this type of gas are believed to be immense. Indeed, some analysts have put the figure as high as 25 percent of the world total. Much of the recent finds are in Qatar, the UAE, and Bahrain. As yet, though, no firm figures have been released.

Published estimates of GCC proven reserves of natural gas place the total in the neighbourhood of 5,426 billion cubic meters in 1980. This represents about 22.5 percent of OPEC's total reserves and about 7.4 percent of the world total. Again, although proven reserves in the region doubled between 1971 and 1980, so did the OPEC and world reserves. Thus, GCC percentage shares of proven reserves were not much different in 1980 from what they had been in 1971. The largest present reserves are in Saudi Arabia and in Qatar's North West Dome.

The separate availability of natural gas in abundance in the region adds a new dimension to its energy stature in the world context. But more importantly, it enables the region to move more solidly into petrochemical production since gas feedstocks into this industry are noted for being superior to refined petroleum. To underscore this point, we present, in Tables 7-7 and 7-8, a synopsis of the chemical composition of some selected samples of gas reservoirs in the region. It is clear from these tables that the dominant compound is methane, in both natural and associated gas wells. In the case of associated gas, ethane is the second most abundant compound, whereas nitrogen is the second most abundant compound in natural gas wells. Methane is the lightest gas and liquefies at 260°F below zero. It is mainly used for power generation, water desalination, fuel at refinery plants, aluminum and cast iron production, and as a feedstock for petrochemical production, particularly fertilizers and methanol. Ethane liquefies at 129°F below zero. It is the most important feedstock into the production of plastics, synthetic fibres, and synthetic detergents.

The other types of compounds can be used in making a variety of products. Of special note here are propane and butane, which liquefy at much higher temperatures than ethane or methane (propane at 45°F below zero, butane at 14°F below zero), and are consequently cheaper to liquefy and to transport in liquid state.

Pentane and heavier compounds are better known as natural gasoline and can be mixed with crude oil or naphtha as a feedstock or can be refined and sold as a fuel separately. The remaining compounds are basically impurities that need to be separated. One of these, hydrogen sulphide, can be used to produce sulphur.

7-4. PRESENT UTILIZATION AND FURTHER PROCESSING OF GCC OIL AND GAS RESOURCES

The dramatic increases in the national incomes of the GCC states as oil prices increased still left their economies outside the oilfields in a relative state of underdevelopment. Levels of living in the region have certainly risen, but essentially and primarily through a form of capital consumption, namely the depletion of oil reserves.

The GCC member states are increasingly aware of the fact that any major devaluation of their oil would likely bring financial difficulties, and that at any rate their oil is a finite resource whose end is in sight of even the present generation for at least three member states -- Qatar, Bahrain, and Oman, as was noted earlier.

Were oil revenues to last forever, there would be no need for diversification or concern about alternative sources of income. A continuous stream of rent would accrue to the government, which could in turn pass it on to the citizens as dividends. But this unfortunately is not the case. With oil revenues variable and finite, alternative sources of income are necessary. At the same time, ways and means must be examined to up-grade the revenues from the dwindling supplies of oil and gas. The focus of this chapter is on up-grading the value added component of the gross output of hydrocarbons. Diversification issues, although not separable from the up-grading issue, are different, and will be treated in a later chapter.

The GCC states are no longer satisfied with their role as crude oil producers. They are moving to build a vertically integrated industrial structure covering transportation, processing, refining, and marketing activities. We will concentrate here on refining and processing, but this does not mean that the other aspects are any less important; they are simply not directly related to the issues of this chapter.

Petroleum Refining

Crude oil by itself does not have direct applications. Its full value is realized after it is processed into refined products for specific end uses. Furthermore, refining is a necessary first step for downstream development of fuel and non-fuel uses. In a series of processes, crude oil is converted into different fuels for energy uses as well as into lubricants, asphalt, waxes, gasoil, and naphtha The last two products are basically feedstocks for the petrochemical industry.

There were less than 900 operational refineries in the world in 1980, with a combined capacity of about 80 million barrels per day. Refineries in the GCC region currently number 13, with a combined capacity of 1.5 million barrels per day, or about 1.9 percent of the world capacity. There are a number of new refineries planned and some are already under construction. By 1986 these would raise the GCC capacity to 3.4 million barrels per day. With this increased refining capacity, the GCC countries, with an expected output of over 15 million barrels per day of crude, would be refining almost a quarter of their production. (See Table 7-9.)

Refining in the GCC region started in Bahrain in 1937 with a 25,000 b/d complex, followed in 1949 by the 25,000 b/d Ahmadi plant in Kuwait, and then by Saudi Arabia's Ras Tanura. These three refineries were, and still are, the largest refining centers in the Arab world. Currently, refining capacity in the region varies between 6,300 b/d (Umm Said) in Qatar to 500,000 b/d (Ras Tanura) in Saudi Arabia. The location, capacity, and type of each refinery in existence or planned are specified in Table 7-10.

The combined output of the GCC refineries will be more than sufficient to meet the expected domestic demand for refined products and therefore will allow for exports. However, unit transport costs are much higher for refined petroleum than for crude oil. Thus, potential GCC exports will depend on transport capacity and the ability to effect reductions in crude oil exports. In 1980, the transport cost differentials between crude and refined oil per barrel were $1.44 to the US East Coast, $1.58 to Japan, $1.29 to North-West Europe, and $1.01 to Southern Europe.[2] These differences in transport costs translate into refining cost differentials between the GCC and consuming countries of $1.30 with the US East Coast, $1.66 with Japan, $1.30 with North-West Europe, and $1.00 with Southern Europe. The differentials are not expected to fall before 1985. Thus, GCC countries are likely to face some difficulty in supplying refined products, except on a supply-demand balancing basis (filling gaps). Thus, a decision to expand refining capacity should be coupled with a decision to reduce exports of crude petroleum. Increased production should be directed to markets where competitive supplies are limited and capacity to transport the products on domestic ships should be expanded so as to counteract conference shipping rates which discriminate against processed products. Moreover, there are a number of other issues that need to be considered in the decision to expand refining capacity. In particular, there is the issue of industrial linkages in both directions, forward and backward. Complementarity with petrochemical processes needs to be considered and feed-back effects on engineering and design skills should be taken into account. Capital cost differentials between the Gulf and OECD countries (now about 50 percent) should be reduced, where possible, by increased domestic involvement in the conception, design, procurement, installation, and operation of refineries. The experience of Iraq in regard to the Basra refinery suggests that a significant reduction in capital costs may be effected through reliance on domestic capabilities.

Natural Gas Liquefaction

The price of oil was relatively low before 1973, and as a result no capital investments were made to exploit the associated gas through liquefaction and export. After 1973, capital investments became economically feasible and many GCC countries moved to utilize their flared gases. Some started to liquefy methane and ethane, only to discover that this was costly and returned low net profits. Liquefaction at low temperatures (260°F below zero for methane, 129°F below zero for ethane), the use of refrigerated carriers, and the need to change liquid gas back to its gaseous state at the points of destination, proved too costly to net enough return on the large capital investments required. More recently, there has been a concentration on the liquefaction of propane, butane, and natural gasoline.

Existing liquid natural gas production capacity in the GCC region is in the neighbourhood of 23.2 thousand tons per year. Allowing for planned expansion, capacity in 1985 is expected to exceed 42.5 thousand tons. (See Table 7-11.) Propane production is expected to be 15 thousand tons per year, whereas butane and natural gasoline will each account for 11.2 thousand tons per year. Saudi Arabia alone will produce more than 50 percent of the expected total output. Kuwait and UAE will each produce over 8 thousand tons per year.

Petrochemicals

Hydrocarbons from petroleum and natural gas account for most of the chemicals produced today. Although it is difficult to devise a simple system of classification to include all petrochemicals, it is customary now to use three broad categories to identify these products, namely, basic, intermediate, and final products.

The main petrochemical basic products are the olefins (ethylene, propylene, butadiene), aromatics (benzene, toluene, xylenes), and methanol. Two primary processes are used in their production: steam cracking of naphtha for the olefins and catalytic reforming for the aromatics. A third process -- steam reforming -- is also used to synthesize ammonia and methanol. These products form the building blocks from which final petrochemical products are made. The processing chains from the basic to the final products are many and complex. However, a few chains dominate: ethylene and propylene are the main inputs in the making of plastics; aromatics in the making of synthetic fibers; butadiene and benzene in the production of rubbers; and methanol (converted into formaldehyde) in the manufacture of adhesives.

The economics of petrochemical production is also complex, involving complex technologies, large minimum efficient scales of production, high rates of product obsolescence, rising feedstock prices, and the dominance of TNCs in the supply of petrochemical intermediates and performance products.

GCC countries are, however, in a privileged position when it comes to petrochemical products, given their abundant supplies of hydrocarbons, some of which are still virtually untapped (flared gas), and their abundant financial capital that could be productively invested in petrochemical production. Moreover, the low labour coefficients in petrochemical complexes match well the desire of GCC producers to reduce their reliance on foreign labour. In addition, in processing their own raw materials, GCC countries will increase the proportion of value added embodied in their resource-based products, diversify the market outlets for their products, and expose themselves to the industrial experience that is necessary for effective diversification of their overall economic structures.

The high rate of product obsolescence, the dominance of TNCs, and the high proportion of cost represented by feedstock call for a strategy of production in the GCC that concentrates on mature products whose markets can be captured by price undercutting. Thus, production of basic and simple intermediate products should precede the production of performance or end products. This does not argue for a total neglect of the end products; rather it argues for a gradual escalation of the complexity of the product structure in step with increasing experience. The historical record of this industry reveals a strong tendency for migration of production across geographical areas. Production started in the US but migrated to Western Europe, then to Japan, and now to the Centrally Planned Economies. There is nothing to preclude its migration to what might be regarded as its "natural abode" in the Arabian Gulf. The excess capacity of production in Europe and Japan is economically inefficient and vulnerable. The Arabian Gulf producers could use their strong leverage in world trade -- they are large importers -- and their position as major oil suppliers to obtain a substantial share of the market.

The high capital costs of petrochemical projects in the GCC region are balanced by the low variable costs of production. Besides, the capital costs themselves could be lessened by increasing the levels of domestic inputs in design, installation, and management. The increased commitment of resources to build large-scale complexes increases the credibility and perceived seriousness of the GCC countries in the quest for a share of the world market.

There was a long time lag between oil production and the development of petrochemical production in the GCC region. Low oil prices, and consequently limited capital, precluded the development of such a capital-intensive industry as petrochemicals. It was not until the late 1960s that petrochemicals were produced in the region. Fertilizers were first produced in Kuwait in 1966, and then at Dammam, in Saudi Arabia, in 1970. Since then, a large number of factories have been established in the region, producing urea and other types of fertilizers, and further development is underway. Table 7-12 presents figures relating to the existing and planned capacity for fertilizer production in the GCC region.

Qatar was the first GCC country to embark on the production of basic petrochemical products, with an ethylene complex in the industrial zone at Umm Said in 1974. The complex had a capacity of 280 thousand tons per year of ethylene and 140 thousand tons per year of LDPE. It was further expanded in 1980 to allow the production of 70 thousand tons per year of HDPE.

There is currently no production of petrochemicals other than fertilizers in Kuwait. However, as Table 7-13 shows, a number of projects are contemplated. Similarly, the UAE is also planning a number of new projects, but there is none on line yet. Ethylene production is the main product planned by the Abu Dhabi National Oil Company. In Kuwait, however, a whole range of basic, intermediate and final products are being studied (e.g., ethylene, HDPE, ethylene glycol, styrene, ortho-xylene and para-xylene).

A joint venture is under construction in Bahrain to produce ammonia and methanol. Planned production of 1,000 tons per day of each is scheduled for 1984. Saudi Arabia, Bahrain, and Kuwait are cooperating in this venture. There are no other petrochemical projects in Bahrain. Oman is currently studying the feasibility of producing ammonia and urea.

The largest regional petrochemical complexes are planned for Saudi Arabia, and two large industrial cities are under construction to accommodate them. The Saudi Arabia Basic Industrial Corporation (SABIC) is entrusted with operating these complexes, together with a number of TNCs. By 1986, the aggregate productive capacity is expected to reach 1.5 million tons per year of ethylene, 660 thousand tons of LDPE, and 1.25 million tons of methanol, together with some small quantities of other products. (See Table 7-13.)

By the mid-1980s, the combined capacity of production of petrochemicals in the GCC countries will include the following: about 2.7 million tons per year of ethylene, or about 5.7 percent of expected world production; 1.6 million tons per year of methanol, or 9.5 percent of world production; 280 thousand tons per year of ethanol, or 7 percent of world production; 655 thousand tons per year of ethylene glycol, or 12.1 percent of world production; 635 thousand tons per year of styrene, or 5.4 percent of world production; 800 thousand tons per year of LDPE, or 5.1 percent of world production; 400 thousand tons per year of HDPE, or 4.9 percent of world production; and 3.2 million tons per year of ammonia, or 6.8 percent of world production. (See Tables 7-12 and 7-13.)

These shares are not high, and certainly far below the shares of proven reserves of gas and oil in the region and the corresponding production and export shares. The restriction of output to a narrow range of products is a wise short-term decision; broadening the base should be tied to the gaining of marketing experience.

Equally important is the linking of investments abroad to GCC exports. This has already happened, but further and immediate attention is called for. There are today a number of projects. Kuwait, for example, owns 40 percent of the Turkish Mediterranean Petrochemical Company. The Kuwaiti Fund is financing a urea and ammonia complex in Sri Lanka. Qatar owns 40 percent of the French North Company which operates a petrochemical complex in France. Saudi Arabia has a petrochemical joint venture in Pakistan and another is contemplated with India.

7-5. CONCLUSIONS

The GCC is the largest oil producer in the world with the largest pool of proven reserves. What is not so often appreciated is that the region also has large gas reserves.

The abundance of oil and gas in the GCC region is nonetheless a temporary phenomenon, as these resources are non-renewable and will run out eventually.

Moving "downstream" to integrate the various phases and sequences of production -- refining, processing, marketing -- has become a dominant strategy for the region. Up-grading the domestic value-added component of resource-based products, providing a productive vent for their financial surpluses, diversification of the markets for their products, vertical integration, and control over the basic resources form the essential goals of a policy of industrial development.

The choice of mature products where the highest fraction of production cost is the value of raw materials, and where vulnerability to technological obsolescence is least, is a wise initial choice. The commitment of large funds to large complexes is an intelligent and credible threat strategy to persuade competitors of the seriousness of the Gulf producers' intention to penetrate world markets in these products, and hence to back off themselves. The choice of joint ventures with TNCs should be complemented, perhaps on a larger and broader scale, with joint processing complexes in the Third World.

The range of petrochemical products should be narrow for the short term, but this need not be the case for the long term. The production of aromatics is one of the more promising possibilities in the shorter term.

A strategy of collective action may be effective in obtaining an increased share of world production for the GCC region. Competition among the GCC countries is harmful to all and rationalization of production calls for a common strategy. Size is a strategic variable in the petrochemical industry, not only from the point of view of scale economies, but also in terms of power in world markets. This industry has a natural linkage to the resource base of the region; raw material costs exceed 75 percent of total production costs in the case of most of the products and represent a large share of total costs generally for the industry as a whole. The credibility of the GCC in its stated intention to capture a large share of world markets increases with the amount of capital committed and with the perceived extent of cooperation and collective action by the countries of the region.

FOOTNOTES FOR CHAPTER 7

1. Two points should be noted here: first, Oman and Bahrain are not members of OPEC; secondly, the neutral-zone share is not included in the GCC total. The latter share would increase output by 500 barrels per day.
2. These figures are taken from Abdelaziz Alwattari, Oil Downstream: Opportunities, Limitations and Policies, Kuwait, OAPEC, 1980, p. 81 (Table 8).

TABLE 7-1: GCC PROVEN CRUDE OIL RESERVES, 1970-1980
(MILLIONS OF BARRELS)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
KUWAIT	79950	78198	72900	72750	81450	71200	70550	70100	69440	68530	67930
QATAR	4300	6000	7000	6500	6000	5850	5700	5600	4000	3760	3585
SAUDI ARABIA	141350	157475	146000	140750	173150	151800	153150	153100	168940	166480	168030
UAE	12783	20502	22768	25500	33920	32200	31200	32425	31316	29411	30410
OMAN*	1100	1000	1500	1700	1600	1500	1500	1800	2000	2300	2400
BAHRAIN*	330	360	380	360	330	310	311	290	270	251	233
G.C.C.	112613	121535	250548	247560	296450	262860	262411	263315	275966	270732	272588
OPEC	412431.0	430983.0	428373.0	421815.0	484970.0	449870.0	438995.0	439915.0	444936.0	435591.3	434355.0
WORLD	611397.5	631856.2	666883.3	627856.5	715697.2	658685.7	636990.3	645847.9	641607.8	641623.5	648524.7
OPEC/WORLD (%)	67.5	68.2	64.2	67.2	67.8	68.3	68.9	68.1	69.3	67.9	67.0
GCC/OPEC (%)	27.3	28.2	58.5	58.7	61.1	58.4	59.8	60.0	62.0	62.2	62.8
GCC/WORLD (%)	18.4	19.2	37.6	39.4	41.4	39.9	41.2	40.8	43.0	42.2	42.0

SOURCE: Oil and Gas Journal, various issues; in the cases of Oman and Bahrain, data are taken from World Production and Reserve Statistics, Oil and Natural Gas, 1980 (Petroconsultants SA).

TABLE 7-2: GCC CRUDE OIL PRODUCTION, 1970-1980
(THOUSANDS OF BARRELS PER DAY)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
KUWAIT	2989.6	3196.7	3283.0	3020.4	2546.1	2084.2	2145.4	1969.0	2131.4	2500.3	1663.7
QATAR	362.4	430.7	482.4	570.3	518.4	437.6	497.3	444.6	486.7	508.1	471.4
SAUDI ARABIA	3799.1	4768.9	6016.3	7596.2	8479.7	7075.4	8577.2	9199.9	8301.1	9532.6	9900.5
UAE	799.6	1059.5	1202.7	1532.6	1678.6	1663.8	1936.4	1998.7	1830.5	1830.7	1701.9
OMAN*	322.0	294.0	281.0	293.0	291.0	342.0	366.0	340.0	314.0	295.0	283.0
BAHRAIN*	77.0	75.0	70.0	68.0	67.0	61.0	58.0	58.0	55.0	51.0	48.0
GCC	8349.7	9824.8	11335.4	13080.5	13580.8	11664.0	13580.3	14010.2	13118.7	14717.7	14068.5
OPEC	23413.0	25326.3	27094.4	30988.5	30729.2	27155.0	30737.7	31253.4	29805.3	30928.8	26878.4
WORLD	45719.5	48218.8	50850.2	55802.5	56088.4	53384.0	57883.2	59862.8	60142.5	62747.4	59740.1
OPEC/WORLD (%)	51.2	52.5	53.3	55.5	54.8	50.9	53.1	52.2	49.6	49.3	45.0
GCC/OPEC (%)	35.7	38.6	41.8	42.2	44.2	43.0	44.2	44.8	44.0	47.6	52.3
GCC/WORLD (%)	18.3	20.4	22.3	23.4	24.2	21.8	23.5	23.4	21.8	23.5	23.5

SOURCE: OPEC, Annual Statistical Bulletin, 1980, and MacNaughton, Twentieth Century Petroleum Statistics, Petroleum Intelligence Weekly; in the cases of Oman and Bahrain, data are taken from World Production and Reserve Statistics, Oil and Natural Gas, 1980 (Petroconsultants SA).

TABLE 7-3: GCC CRUDE OIL EXPORTS
(THOUSANDS OF BARRELS PER DAY)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
KUWAIT	2579.9	2775.2	2925.0	2641.6	2203.2	1803.4	1790.9	1624.8	1761.2	2083.1	1296.5
QATAR	362.8	482.6	481.7	570.3	511.2	428.3	486.6	410.3	480.0	494.9	465.7
SAUDI ARABIA	3216.9	4186.8	5444.1	7014.6	7922.4	6601.1	8031.8	8608.4	7706.0	8817.7	9223.2
UAE	777.0	1054.8	1202.7	1522.1	1689.5	1661.4	1932.8	1990.0	1816.3	1805.3	1697.3
OMAN	332.1	291.1	280.3	292.5	289.9	342.2	367.9	334.2	315.9	295.0	n.a.
BAHRAIN	-	-	-	-	-	-	-	-	-	-	-
GCC	7268.7	8790.5	10333.8	12041.1	12616.2	13836.4	12610.0	12967.7	12079.4	13496.0	n.a.
OPEC	20223.4	22031.7	24078.5	27547.2	27258.9	24063.9	27462.6	27641.1	26088.7	26838.5	22888.7
WORLD	23435.8	25541.1	27953.5	31569.2	31344.1	28519.3	32085.9	32314.5	31272.5	33835.7	30616.6
OPEC/WORLD (%)	86.3	86.3	86.1	87.3	87.0	84.4	85.6	85.5	83.4	79.3	74.8
GCC/OPEC (%)	35.9	39.9	42.9	43.7	46.3	57.5	45.9	46.9	46.3	50.3	n.a.
GCC/WORLD (%)	31.0	34.4	37.0	38.1	40.3	48.5	39.3	40.1	38.6	40.0	n.a.

SOURCE: OPEC, Annual Statistical Bulletin, various issues, and US Department of Energy, International Petroleum Annual, various issues.

TABLE 7-4: PRODUCTION AND UTILIZATION OF NATURAL GAS IN THE GCC REGION: SELECTED YEARS
(MILLIONS OF CUBIC METRES PER YEAR)

	1971			1975			1980		
Country	Production	Flared	% Waste	Production	Flared	% Waste	Production	Flared	% Waste
KUWAIT	18228	11979	65.7	11208	4310	38.5	8780	1416	16.1
QATAR	4514	3509	77.7	4730	3524	68.8	6400	1190	18.6
SAUDI ARABIA	25481	19896	78.1	4723	37412	79.2	53265	38368	72.0
UAE (Abu Dhabi)	10430	9385	90.0	14309	12938	90.4	14859	7608	51.2
BAHRAIN	506	n.a.	n.a.	3043	n.a.	n.a.	3715	509	13.7
GCC	59159	44769	75.6	80520	58184	72.3	87688	49091	55.9

SOURCE: OPEC, Annual Statistical Bulletin, various issues; in the case of Bahrain, data are taken from GOIC, Petrochemical Industries in the Arabian Gulf, 1980, p. 37, and OAPEC, Annual Statistical Report, 1982.

NOTE: Comparable data were not available for Oman; data for the UAE include only Abu Dhabi.

TABLE 7-5: GCC GROSS PRODUCTION OF NATURAL GAS, 1971-1980
(MILLIONS OF CUBIC METRES PER YEAR)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
KUWAIT	18228	18344	16454	13222	10827	11208	10272	11124	13035	8780
QATAR	4514	5097	6213	5151	5437	4730	4290	4650	6677	6400
SAUDI ARABIA	25481	32568	44292	47310	37812	47230	48700	43748	50561	53265
UAE	10430	11215	13690	13054	12233	14309	15341	13553	13700	14859
OMAN	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
BAHRAIN	506	1132	1602	1975	2876	3043	3432	3715	3715	3715
GCC	59159	68356	82251	80712	69185	80520	82035	76790	87688	87019
OPEC	197221	213633	251964	250794	222217	253706	268611	268327	302618	270412
WORLD*	1179000	1239000	1309000	1346000	1349000	1380000	1436000	1477000	1565000	1565000
OPEC/WORLD (%)	16.7	17.2	19.2	18.6	16.5	18.4	18.7	18.2	19.3	17.2
GCC/OPEC (%)	30.0	32.0	32.6	32.2	31.1	31.7	30.5	28.6	28.9	32.2
GCC/WORLD (%)	5.0	5.5	6.3	6.0	5.1	5.8	5.7	5.2	5.6	5.6

SOURCE: OPEC, Annual Statistical Bulletin, various issues; US Department of Energy, World Natural Gas Annual; Institute of Geological Sciences, World Mineral Statistics, various issues; GOIC, Petrochemical Industries in the Arabian Gulf, November, 1980, p. 37.

TABLE 7-6: GCC PROVEN NATURAL GAS RESERVES 1971-1980
(BILLIONS OF CUBIC METRES)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
KUWAIT	908.7	856.2	851.9	833.5	828.9	791.3	786.7	782.2	775.3	768.0
QATAR	181.8	181.8	181.8	181.8	170.5	625.0	909.1	909.1	1363.6	1363.6
SAUDI ARABIA	1295.1	1242.6	1270.1	1356.2	2447.1	1502.6	2002.6	2204.9	2189.7	2568.0
UAE	250.0	295.0	340.9	463.6	521.6	511.4	488.6	490.9	465.9	472.2
OMAN	46.3	46.3	46.3	48.6	46.3	46.3	46.3	46.3	46.3	46.3
BAHRAIN	92.5	92.5	92.5	152.7	127.3	69.4	69.4	162.0	208.3	208.0
GCC	2774.4	2714.4	2783.6	3036.4	4141.7	3546. 0	4302.7	4433.4	5049.1	5426.1
OPEC	12616.7	12605.9	14938.0	23119.8	18361.8	18107.3	23564.6	23379.8	23869.9	24063.5
WORLD	47349.9	52214.1	56486.9	68816.7	61787.3	63259.4	69246.7	69341.7	71319.6	73461.6
OPEC/WORLD (%)	26.6	24.1	26.4	33.6	29.7	28.6	34.0	33.7	33.5	32.8
GCC/OPEC (%)	22.0	21.5	18.6	13.1	22.6	19.6	18.3	19.0	21.2	22.5
GCC/WORLD (%)	5.9	5.2	4.9	4.4	6.7	5.6	6.2	6.4	7.0	7.4

SOURCE: Oil and Gas Journal, various issues.

TABLE 7-7: AVERAGE CHEMICAL STRUCTURE OF ASSOCIATED GAS IN SELECTED GCC COUNTRIES

Country / Compound	% Volume			
	Bahrain	Qatar (off-shore fields)	Ghawar	UAE (Abu Dhabi)
Methane	70.2	55.5	51.0	55.7
Ethane	6.6	13.3	18.5	16.6
Propane	4.5	9.7	11.5	11.6
Iso-butane	0.7	1.6	--	1.6
Butane	2.0	4.0	4.4	3.8
Pentane	1.6	2.6	1.6	--
Hexane	0.9	1.1	0.4	0.7
Heptane and heavier	0.5	1.2	0.2	0.9
Carbon Dioxide	4.6	7.0	9.7	5.6
Hydrogen sulfide	--	2.9	2.2	0.8
Nitrogen	8.3	1.1	0.5	0.6
Other	--	--	--	--
Total	100.0	100.0	100.0	100.0

SOURCE: *Oil and Gas Journal*, various issues.

TABLE 7-8: AVERAGE CHEMICAL STRUCTURE OF NATURAL GAS (DRY) IN SELECTED GCC COUNTRIES

	% Volume		
Country / Compound	Bahrain	Qatar (Gas Khaf)	UAE (Dubai-Rashid)
Methane	80.0	80.0	78.6
Ethane	1.7	1.3	9.2
Propane	0.4	0.4	3.8
Iso-butane	0.1	0.1	0.6
Butane	--	0.1	1.3
Pentane	0.1	0.2	0.9
Hexane	0.1	--	0.5
Heptane and heavier	--	0.1	0.7
Carbon dioxide	6.6	4.4	3.7
Hydrogen sulfide	--	0.2	0.4
Nitrogen	10.9	13.6	0.3
Other	--	--	--
Total	100.0	100.0	100.0

SOURCE: *Oil and Gas Journal*, various issues.

TABLE 7-9: OIL REFINING CAPACITY IN THE ARABIAN GULF
(THOUSANDS OF BARRELS PER CALENDAR DAY AT YEAR END)

All capacity	Existing capacity 1981	Firm capacity 1986	Firm capacity increase 1981 - 86	Additional possible capacity* 1981 - 86	Firm + possible capacity increase 1981 - 86	Total firm + possible capacity 1986
UAE	15	195	180	550	730	745
Bahrain	250	250	-	-	-	250
Saudi Arabia	644	2,234	1,590	53	1,643	2,287
Oman	-	50	50	50	50	50
Qatar	11	61	50	-	50	61
Kuwait	594	594	-	106	106	700
TOTAL -	1,514	3,384	1,870	709	2,579	4,093
ESTIMATED EXPORT CAPACITY**						
UAE	-	100	100	550	650	650
Bahrain	225	200	(25)	-	(25)	200
Saudi Arabia	300	1,365	1,065	53	1,118	1,418
Oman	-	-	-	-	-	-
Qatar	-	-	-	-	-	-
Kuwait	475	475	-	106	106	581
TOTAL	1,000	2,140		709	1,849	2,849

SOURCE: Based on Field Missions and Reports of GOIC.

NOTE: * 1981 on-stream + under construction + committed (e.g., contract let as of Mid-January 1981).
** Estimated on basis of announced intentions and domestic market growth expectations.
- Figures in parentheses indicate decreases.

TABLE 7-10: OIL REFINERIES IN THE GCC REGION, 1980

Country	Location	Capacity b/d	Type
1. Kuwait	Mina Abdallah	120,000	D
	Mina Saoud	50,000	D/R/B
	Shuaiba	180,000	D/H/R/C
	Mina Abdallah	120,000	D/H
	Mina Ahmadi	250,000	D/R/B
	Mina Ahmadi (under construction)	250,000	H/L
2. Saudi Arabia	Ras Tanura	500,000	D/R/B
	Jeddah	70,000	D/R/B/H/VIS
	Riyadh	20,000	D/H/VIS/R
	Ras Tanura (under construction)	25,000	R
	Jeddah (expansion)	170,000	D/VIS/R
	Al-Jubail (under construction)	120,000	D
	Yanbu (under construction)	250,000	D
	Al-Jubail (under construction)	250,000	D
	Riyadh (expansion)	120,000	D/R/H
	Rabgh (under construction)	350,000	D
3. Bahrain	Awali	250,000	D/C/R/VIS/B
4. Qatar	Umm Said	6,321	D/R
	Umm Said (planned)	50,000	D/R
5. UAE	Umm Al-Naar	15,000	D/R/H
	Ruwais	120,000	D/R/H
	Jebel Ali	200,000	D/R/H
6. Oman	(under construction)	50,000	-

SOURCE: GOIC, Petrochemical Industries in the Arabian Gulf, November, 1980, p.42.

KEY: B = Bitumen, C = Cracking, D = Distillation, H = Hydrocracking, L = Lubricating oil,
R = Reforming, VIS = Visbreaking.

TABLE 7-11: LIQUID NATURAL GAS PROJECTS IN THE GCC REGION

	Country	Location	Present status	Feedstock MCF/day	Products (thousand tons/year)					
					Ethane	Propane	Butane	Natural gasoline	LNG	Total liquid gases
1.	Kuwait	Mina Ahmadi	Operational	554	-	556	560	476	-	1,592
		Shuaiba	Operational	1,680	-	3,176	1,717	1,716	-	6,609
		Subtotal	-	2,234	-	3,732	2,277	2,192	-	8,201
2.	Saudi Arabia	Ras Tanura	Operational	1,000	-	3,500	3,000	3,000	-	9,500
		Juaima	Under construction	-	1,423	2,851	2,190	1,914	-	8,378
		Yanbu	Under construction	3,000	1,262	2,376	1,200	990	-	5,828
		Subtotal	-	-	2,685	8,727	6,390	5,904	-	23,706
3.	Bahrain	Manama	Operational	100	-	80	75	125	-	280
4.	Qatar	Umm Said	Operational	360	-	336	270	270	-	876
		Umm Said	Under construction	340	-	270	157	113	-	540
		Subtotal	-	700	-	606	427	383	-	1,416
5.	UAE	Das Island	Operational	550	-	650	420	220	2,300	3,590
		Al-Ruwais	Under construction	913	-	950	1,426	2,138	-	4,514
		Jebel Ali	Operational	140	-	311	222	244	-	777
		Subtotal	-	1,603	-	1,911	2,068	2,602	2,300	8,881
	GCC Region	-	Operational	-	-	8,609	6,264	6,051	2,300	23,224
		-	Under construction	-	2,685	6,447	4,973	5,155	-	19,260
		-	Total	-	2,685	15,056	11,237	11,206	2,300	42,484

SOURCE: GOIC. Petrochemical Industries in the Arabian Gulf November, 1980. P. 40.

NOTE: MCF stands for millions of cubic feet.

TABLE 7-12: EXISTING AND PLANNED FERTILIZER INDUSTRIES IN THE GCC REGION

Country	Location	Products	Capacity thousand tons/year	Status
1. Kuwait	Shuaiba	Ammonia	660	Operating since 1966
Petrochemical Industries	Shuaiba	Urea	792	Operating since 1971
Corporation	Shuaiba	Ammonium sulfate	165	Operating since 1971
	Shuaiba	Ammonia	330	Planned
2. Saudi Arabia				
SAFCO	Dammam	Ammonia	180	Operating since 1970
	Dammam	Urea	300	Operating since 1970
SEMAD	Al-Jubail	Ammonia	330	Operational in 1983
	Al-Jubail	Urea	500	
	Al-Jubail	Ammonia	330	Under study
		Urea	500	
3. Bahrain				
Gulf Petrochemical Corporation (joint venture)	Satrat	Ammonia	330	Operational in 1984
4. Qatar	Umm Said	Ammonia	297	Operating since 1973
QAFCO	Umm Said	Urea	330	Operating since 1973
	Umm Said	Ammonia	297	Operating since 1979
		Urea	330	Operating since 1979
5. UAE	Al-Ruwais	Ammonia	330	Operational in 1983
ADNOC	Al-Ruwais	Urea	500	Operational in 1983
6. Oman				
Ministry of Oil and Mineral Resources	Sahar	Ammonia	200	Planned
		Urea	330	

(Continued...)

TABLE 7-12: (Continued...)

7. GCC Region	Ammonia	1434	Operating
	Urea	1752	Operating
	Ammonia	990	Operational in 1983-84
	Urea	1000	Operational in 1983-84
	Ammonia	860	Planned or under study
	Urea	830	Planned or under study
	Ammonia	3284	Total
	Urea	3582	Total
	Ammonium sulfate	165	Total

SOURCE: GOIC, Petrochemical Industries in the Arabian Gulf, November, 1980, p.48.

TABLE 7-13: EXISTING AND PLANNED PETROCHEMICAL PROJECTS IN THE GCC REGION

Country	Location	Products	Capacity thousand tons per year	Status
1. Kuwait				
KPIC	Shuaiba	Ethylene	350	Planned
		HDPE	130	Planned
		Ethylene glycol	135	Planned
		Styrene	340	Planned
		Benzene	280	Planned
		Ortho-xylene	60	Planned
		Para-xylene	86	Planned
2. Saudi Arabia				
a) Saudi Petrochemical Co. (Shell Oil Co.)	Al-Jubail	Ethylene	656	Operational in 1985
		Ethylene dichloride	456	
		Styrene	295	
		Ethanol	281	
		Caustic soda	377	
b) Saudi Yanbu Petrochemical Co. (Mobil Chemical Co.)	Yanbu	Ethylene	450	Operational in 1985
		LDPE	200	
		HDPE	90	
		Ethylene glycol	220	
c) Al Jubail Petrochemical Co. (Exxon Chemical Co.)	Al-Jubail	LDPE	260	Operational in 1985
d) Saudi Methanol Co. (Japanese Consortium)	Al-Jubail	Methanol	600	Operational in 1983
e) National Methanol Co. (Celanese-TEXAS Eastern)	Al-Jubail	Methanol	650	Operational in 1985
f) Arabian Petrochemical Co. (Dow Chemical Co.)	Al-Jubail	Ethylene	500	Operational in 1985
		LDPE	70	
		HDPE	110	
g) Eastern Petrochemical Co. (Japanese Consortium)	Al-Jubail	LDPE	130	Operational in 1985
		Ethylene glycol	300	

(Continued...)

TABLE 7-13: (Continued...)

Country	Location	Products	Capacity thousand tons per year	Status
3. Bahrain Gulf Petrochemical Industries jointly with Kuwait and Saudi Arabia	Satrat	Methanol	330	Operational 1984
4. Qatar QAPCO & CDF	Umm Said	Ethylene	280	Operational
		LDPE	140	
		Propylene	5	
		HDPE	70	
5. UAE (ADNOC)	Al-Ruwais	Ethylene	450	Under consideration
6. GCC Region		Ethylene	2686	Total operational, operational in 1985, planned or under study
		Ethylene dichloride	456	
		Ethylene glycol	655	
		HDPE	400	
		LDPE	800	
		Styrene	635	
		Benzene	280	
		Propylene	5	
		Ortho-xylene	60	
		Para-xylene	86	
		Methanol	1580	

SOURCE: Al-Wattari, Oil Downstream (Kuwait: OAPEC, 1980), pp. 98 and 99, and SABIC, The Fourth Annual Report for 1400 A.H. (1980 A.D.), p. 22.

CHAPTER 8

METALLIC MINERALS

8-1. DEFINITIONS

The mineral resources of the GCC region have been grouped into two major categories, depending on the chemical characteristics of the element or chemical compound of interest. The first category comprises mineral resources containing metallic elements and is discussed in this chapter. The second category comprises non-metallic minerals and is discussed in the next chapter.

The mineral resources of the region are described in tabular form, separately for each mineral or element of interest, and for each GCC member country. Wherever data allow, estimates of the total reserves available in the GCC region for each resource are presented. The following definitions apply to terms used in Chapters 8 and 9 and are the definitions used by the Directorate General of Mineral Resources of Saudi Arabia, as presented in the Geologic Map GM-66 of 1982:

Occurrence: A mineral occurrence that has been investigated but not drilled.

Prospect: A mineral occurrence that has been considered sufficiently favourable to warrant at least one drillhole.

Deposit: A prospect found to have substantial tonnage of mineralization although not necessarily economic at present.

In the tables presented in this chapter and the next one, only mineral deposits are listed. Smaller mineral occurrences, although numerous, have not been included in the tables. The information reported on each deposit was verified through one or more additional references, whenever information was available. During this process of cross-checking it was noted that few deposits were referred to in the literature under different names. In such cases, the geographical coordinates of the deposit and the name of the locality on the 1982 Mineral Locality Map of the Directorate General of Mineral Resources of Saudi Arabia were used in an effort to correlate the information. The Directorate General of Mineral Resources has also established a computerized Mineral Occurrence Documentation System (MODS) which contains all available data concerning every ore formation of metallic and non-metallic minerals in Saudi Arabia. The information contained in the MODS system was not made available to us for use in this report. Consequently, the information reported had to be pieced together from such other references as were available. Similarly, a comprehensive study of the mineral resources of the United Arab Emirates, which was well in progress at the time of our field trip to the UAE, was not available to us. Wherever possible, the reported metallic mineral resources have been presented roughly in order of significance, with the geologically or chemically related resources (for example copper, zinc, and lead) presented in sequence.

8-2. METALLOGENESIS AND GEOLOGICAL SETTING OF THE AREA

As already discussed briefly in Chapter 4, the GCC region exhibits two major geological environments: the Arabian Shield environment and the Arabian Shelf sedimentary environment. The mineralization and the location of the mineral deposits in the GCC region are a function of the geological characteristics of the region.

Mineralization is closely related to the Arabian Shield, which is composed of folded metamorphic and igneous rocks (basement) covering almost 25 percent of the area of Saudi Arabia. To the east and north, the basement dips under the sedimentary strata of the Arabian Shelf. (See Chapter 4.) The basement appears again to the southeast at the Oman Mountains. The Arabian Shield is the area that presents the highest potential for locating metallic mineral deposits.

On a global scale, metallogenesis appears to have been concentrated within certain distinct geological epochs, different for each element. Within the Arabian Shield, the Precambrian orogenic epoch resulted in the most significant metallic mineralization in the region, producing minerals of heavy metals (iron, copper, zinc, lead, nickel, titanium), as well as gold and silver. In the Oman mountain region, the Alpian geological epoch resulted in the formation of chromium, nickel, manganese, and copper minerals, as well as gold and silver. In addition, hot brines from the deep rift occupying the deep part of the Red Sea bottom have resulted in some mineralization. (Reference 3).

Within the Arabian Shelf there exist thick, gently dipping sediments, where exogenous mineral deposits of sedimentary origin have been developed, such as oil, gas, iron, salt, and clay deposits.

Saudi Arabia, Oman, and the United Arab Emirates exhibit the highest potential for locating metallic mineral resources, since they share the areas where the basement surfaces. However, all of the GCC member states have potential for locating non metallic-mineral resources.

The tables presented in this chapter summarize the major mineral deposits of the GCC region and, as discussed in the next section, these resources are concentrated in Saudi Arabia and Oman, where the basement rocks are on the surface. However, recent developments in the area of underwater mining have transformed the sea bottom to a new region from which mineral resources could be recovered. The presence of manganese nodules on the sea bottom could prove to be a new mineral resource to the GCC countries, as all of them border on the sea. Manganese nodules are rich in minerals, and with further technological advances they could be used to support metallurgical operations.

Bahrain has not identified any metallic mineral resources in its territory. However, taking advantage of rich natural gas deposits, an aluminum smelter has been established with a capacity of 170,000 tons of aluminum per year, which uses alumina imported from Australia, as well as an aluminum extrusion plant. (Reference 6). Furthermore, an iron ore pelletizing plant of 2 million tons per year capacity is under construction and another specialty steel plant (1 million tons per year) is under study. (Reference 15).

Kuwait has not undertaken the construction of heavy industrial plants for smelting or rolling operations. However, it has participated in joint projects, and took part in the 1981 agreement to establish a 40,000 tons per year aluminum smelter in Bahrain. Aluminum extrusion takes place on a small scale in Kuwait. (Reference 6). A pre-feasibility study of the construction of a sponge iron plant has also been undertaken. (Reference 15).

Oman has identified sizable reserves of copper and chromite. Copper ore is currently mined at Sohar in three mines and smelting will be taking place in a copper smelting plant constructed to the east of the mining facilities. (Reference 6). A plan for the construction of a 20,000 tons per year electrolytic refinery for copper has also been adopted by the government. (Reference 7). An integrated steel plant is under construction and an expansion of this plant from 150,000 to 330,000 tons per year is under study. (Reference 15).

Qatar has built an iron processing plant at Umm Said, smelting ore imported from Australia and the U.S., and processing also local scrap iron. The output reached 440,000 tons of iron in 1980, and a possible doubling of this capacity is under study. (References 6,15).

Although metallic mineral deposits of substantial size have been located in Saudi Arabia, apart from hydrocarbons non-metallic minerals are the only minerals produced at present. A steel rolling plant has been built in Jeddah with a capacity of 140,000 tons per year. A new steel plant is to be built at Al-Jubail that will produce 800,000 tons of sponge iron and 800,000 tons of steel products per year. (Reference 6).

In the United Arab Emirates, Dubai has constructed a large aluminum smelting plant at Jebel Ali, and during 1980 it was producing approximately 1,000 tons of aluminum per week, although it had not yet reached full capacity. The plant uses the available natural gas for its operation, while producing substantial volumes of distilled water as a by-product. (Reference 6). A steel rolling mill is in production with a capacity of 45,000 tons per year, while an integrated steel plant of 500-800 thousand tons per year capacity is under consideration. (Reference 15).

In summary, mining operations in the GCC region are very limited at present, while substantial development of metallurgical operations has taken place, or is planned, in the production of aluminium, iron, steel, and copper.

8-3. COMMENTS ON METALLIC MINERAL RESOURCES

The GCC region contains a substantial tonnage of poly-metallic sulfides. The principal economic minerals are pyrite, chalcopyrite and sphalerite, which are, respectively, sources of iron, copper, and zinc. Among the chief gangue materials are quartz, carbonates, and chlorite. Copper is actively mined at present in the Sohar region of Oman and the ore is being smelted into copper (20,000 tons per year); further processing of the copper by electrolytic refining (20,000 tons per year) will take place in the future. In Saudi Arabia there exists a potential for copper mining. The Jebel Said deposit is one example of a deposit that could be developed; it could produce from 1 to 1.3 million tons of ore per year, depending on the method of exploitation. (Reference 3). A second example is the Nuqrah area deposit, which could be considered as economically exploitable by underground mining for a period of up to 12 years at a rate of up to 140,000 tons of ore per year. The deposit is 5 to 7 times richer, in terms of ore value, than the copper deposits in developing and developed countries. (Reference 3). The practice of copper mining, smelting, and planned future refining in the GCC region has produced some experience in the domain of integrated copper production which will be useful in planning any further development in this area. Developing countries account for approximately two thirds of identified world copper reserves, excluding the centrally planned economies and copper in undersea manganese nodule reserves. By 1983, developing countries will account for 58.9 percent of mine production, 43.8 percent of smelting, and 30.6 percent of refining. The existing excess smelting capacity for copper throughout the world suggests that copper concentrates will have little trouble in finding treatment facilities. In fact, the excess capacity may create a larger spot market in concentrates, giving mines a certain degree of freedom in making sales. The prospects for sales of refined copper in the medium term may not be very favourable but there are indications that conditions may improve in the longer-term future. (Reference 8).

The most important lead and zinc mineralization in the GCC region occurs mainly in Saudi Arabia, in the form of polymetallic sulfides. In polymetallic mineralization, the content of lead and zinc can be lower than in monometallic mineralization (as low as 3 to 5 percent zinc) as the other useful components in the ore increase its value. Potential zinc deposits are the copper deposits identified in the Nuqrah area, the Knaiguiyah area, Al-Massani, and Al-Amar. Excluding centrally planned economies, the developing countries' share of world capacity is less for zinc mining and smelting (29 and 15 percent, respectively) than for copper, even though 35 percent of the known zinc reserves are located in developing countries. A very substantial portion of the world zinc industry is controlled by integrated producer groups, accounting for 85 percent of mine output and 95 percent of metal output. The long-term outlook for zinc produced by developing countries can be considered favourable, despite recent weaknesses in the zinc market. (Reference 8). The availability of abundant low cost energy gives an additional advantage to the GCC states with regard to smelting and refining operations.

Lead is also associated with copper and zinc in the GCC region. The long-term outlook for lead is limited, owing to the replacement of lead in several traditional uses by new technology (e.g., gasoline additives, cable sheathing). Saudi Arabia is also actively considering the exploitation of the geothermal brine deposits of the Red Sea and has entered into bilateral agreement with Sudan for the potential development of those deposits.

The principal known iron ore deposits occur in Saudi Arabia and are the Wadi Sawawin, Jebel Idsas, and Wadi Fatima deposits. All three of these deposits are low or very low grade, by world standards. However, with the establishment of an iron and steel industry in the GCC region, these deposits could be considered as possible sources of raw materials. The Wadi Fatima oolitic deposits are not suitable for direct reduction, but the Jebel Idsas deposits could be used domestically for iron and steel production, particularly if blended with imported ore or material from Wadi Sawawin, and assuming that some ore beneficiation problems could be resolved. Currently, about 96 percent of world raw steel capacity is located in developed countries. Because of the relatively low share of iron ore in the final value of finished steel, the need for steel producers to be in touch with the demands of the market in industrialized countries (where the bulk of steel is consumed), and the linking of some specific iron ore mines to steel plants through vertically integrated corporate structures, most developing countries' steel plants produce for a domestic or regional market. There is already substantial overcapacity for steel making in the industrialized countries, so that there appears to be little opportunity for the developing countries to penetrate efficiently the industrialized nations' markets. Estimates by UNIDO indicate that where regional markets exceed about 1 million tons of steel per year, full-scale integrated steel plants can be built economically. The market size can be even smaller if direct reduction technology is adopted, as it has been in the GCC region. (Reference 8).

Aluminum is another metal that is currently produced in the GCC region. An extensive layer of fossil bauxite and smaller deposits of alumina-rich clays have been located in Saudi Arabia. Aluminum production is an energy-intensive activity. Two large aluminum smelting plants are already available in the GCC region, one in Bahrain (170,000 tons per year capacity) and a second in the UAE (Dubai, with 130,000 tons per year capacity), both using imported alumina. Of the present output, about 42 percent is consumed by the domestic producers of extrusions and cables, while the balance is exported. It has been estimated that by the middle of the next decade the regional demand will equal the present supply. Today, in the area, there are aluminum extrusion plants, cable plants, and some final fabrication. Although developing countries provide most of the good-quality bauxite, alumina refining and aluminum production are mainly concentrated in the developed countries. It is estimated that about 36 percent of alumina refining and 21 percent of aluminum production capacity are located in developing countries. Most of the bauxite mined is traded internally among the six major aluminum companies, which account for about three-fifths of the world aluminum market. Bauxite not sold within this set of companies is generally sold to independent producers under long-term contracts. (Reference 8). On the basis of the 1977 World Bank demand projections, the prospects for aluminum in the world markets seem to be good. It appears that the identified pisolitic bauxite deposits in Saudi Arabia, having an average alumina content of about 41 percent, is a serious candidate for consideration in developing an integrated aluminum production structure within the GCC region, starting with alumina refining and ending with aluminum production and rolling. Utilization of available sodium salt reserves could also provide the required caustic soda for alumina production (using the Bayer process).

Other available metallic mineral resources are of lesser significance, although the possibility of future development for some of them should not be excluded.

8-4. BRIEF OVERVIEW

The data presented in Tables 8-1 to 8-14 indicate that, on the basis of the information available thus far, the GCC region has within its territory a substantial tonnage of various metallic minerals. However, these deposits are of relatively small size when compared to similar types of deposits on a global scale. There is substantial regional capacity installed in the production of iron, steel, aluminum, and copper, and expansions are being planned for some of these basic industries (Table 8-14). With regard to copper, significant production capacity is available at present in Oman. This capacity will be expanded further towards electrolytic refining of the produced metal. The copper ore currently used is mined in Oman. The potential for the identification of additional usable copper ore deposits is good, as copper ore formations exist in Saudi Arabia and geophysical exploration continues actively in Oman, Saudi Arabia, and the UAE. The advantages of expanding the present copper production capacity should be weighed carefully against the limitations of regional ore supply and the requirements and prospects of the world copper market.

There exists a very large investment in iron and steel production facilities (Table 8-14). The region has available iron ore pelletizing, sponge iron production, steel making, and steel rolling capacity. The iron ore deposits of the region are located mainly in Saudi Arabia, and are generally of low grade. They could be used by the regional iron and steel industry if blended with imported iron ore. It appears that iron ore production is the link missing in the establishment of a fully integrated iron and steel industry. Consequently, the securing of continuous iron ore supply from possible ownership of iron ore mines located in other developing countries, not too distant from the GCC region, might be considered a preferable alternative to expanding further the region's own iron and steel production capacity. Such investment abroad would provide better control over the sources of supply for the iron and steel industry, would reduce the present dependence of the region on iron ore imports, and would allow the establishment of a fully integrated iron-steel production industrial complex which could play a central role in the efforts towards the diversification of the industrial base of the region and the easing of dependence on the oil sector.

The aluminum production sector of the economy is also very well developed, with both smelting and extrusion plants in operation (Table 8-14). However, aluminum ore mining and alumina production are absent from the region. The recent identification of an extensive layer of pisolitic bauxite in Saudi Arabia, and the potential for the production of caustic soda from high salinity sea water in the region, suggest that the expansion of the aluminum production industry could be directed beneficially towards the regional production of alumina using, to the extent possible, domestic ore. If domestic ore turns out to be insufficient or unavailable for alumina production, then the possibility of investing in foreign mines not too distant from the GCC region could be considered, for the same reasons as in the case of the iron and steel industries. Such expansion would result in the establishment of a fully integrated and independent regional aluminum production base capable of meeting regional market demands and of providing income from sources other than those related to oil.

Other basic industries, such as zinc, lead, gold, and silver, may be considered as having a lesser development potential at the present time, as far as regional resources are concerned. Their future development cannot be ruled out but further study would be required before the desirability of such development could be established.

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TABLE 8-1: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: COPPER (Cu)

Location	Ore Type	Deposit Size	Comments	Sources
Jabel Said	Chalcopyrite, sphalerite, pyrite, pyrrhotite, magnetite	Major deposit of about 20 million tons	Consists of massive mixed sulfides accompanied by gold as well as stringers and lenses of pyrite, pyrrhotite, chalcopyrite. Contains 2% Cu, 1.4% Zn, 0.5 g/t Au, 40 g/t Ag.	2,3,4,5
Nuqrah (Area)	Chalcopyrite, sphalerite, galena, pyrite	Major deposit of 1.35 million tons	Massive and disseminated polymetallic sulfides stratiform mineralization, lenses. Contains over 1.2% Cu, over 2.3% Pb, over 7.6% Zn, over 2.1 g/t Au. It is a high value ore.	2,3,4,5
Rabathan (Wadi Bidah)	Chalcopyrite, sphalerite, pyrite	Over 1.5 million tons	Steep lenses in tightly folded and faulted metamorphosed volcano-sedimentary rocks both massive and disseminated sulfides. Contains 2.14% Cu, 0.02% Zn, 0.15 g/t Au, 2.45 g/t Ag.	2,3,4
Mahd Adh Dhahab	Native gold and silver, sphalerite, pyrite, chalcopyrite, galena, malachite	Major deposit Veins spread over wide area	Remains of ancient mining operations exist in the area. Gold bearing quarts veins in large fault zones. Contains 2.15% Cu, 12.5% Zn, 20.8 g/t Au, 140 g/t Ag.	1,2,4,5
Wadi Shaela	Copper minerals	Major deposit	Contains also tungsten.	2
Knaiguiyah (Area)	Pyrite, chalcopyrite, sphalerite, magnetite hematite	Major depost of 15 million tons	Volcanosedimentary setting similar to that at Jabal Sayid. Includes four areas of interest. Contains 1% to 5% Cu and 5.8% Zn.	2,4,5
Smarhan (Area)	Magnetite, hematite with copper	Major deposit	It is close to Knaiguiyah, a lens 120 m long by 5 to 10 m wide, passing through carbonate rocks on a volcanic sequence. Contains 0.5% Cu.	2,4,5

(Continued...)

TABLE 8-1: (Continued)

Location	Ore Type	Deposit Size	Comments	Sources
Bir Al-Khays	Chalcopyrite, sphalerite	Major deposit	Similar geologic environments to that of Knaiguiyah. Contains about 1.4% Cu and 0.5% Zn.	2,4,5
As-Safra	Chalcopyrite, pyrite	Major deposit of about 27 million tons	Consists of several small bodies of massive and disseminated sulfides. The deposit is still open at depth. Present also 20,000 tons of slug containing over 1% Cu. The ore contains 2% Cu.	1,2,3,4,5
Al-Massani	Sulfides	Major deposit of 5 million tons	The deposit has been traced intermittently for 5 km in a shear zone of tuffaceous beds and intercalated limestone. Contains 1.5% Cu, 6.3% Zn, 93.3 g/t Ag, 2.8 g/t Au.	2,4,5
Qatam	Mixed sulfides	Major deposit of at least 4.5 million tons	Ancient mining location. The ore contains 2.1% Cu, 0.69% Zn, 6.12 g/t Ag and 0.23 g/t Au. Further information on the deposit was classified confidential. Nickel grades range from .5% to 3%.	2,3,4
Shaab At-Tare (Wadi Bidah)	Chalcopyrite, sphalerite, pyrite	Over 4 million tons	The deposit contains 0.36% Cu, 1.09% Zn, 0.55 g/t Au and 3.46 g/t Ag. Consists of massive and disseminated sulfide mineralization.	2,3,4
Wadi Shwas	Pyrite, pyrrhotite, chalcopyrite and sphalerite	Over 1.2 million tons	The area contains several mineralized areas with remains of ancient mining works. The ore contains 2.13% Cu and 1.57% Zn.	4

TABLE 8-2: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: ZINC (Zn)

Location	Ore Type	Deposit Size	Comments	Sources
Nuqrah (Area)	Chalcopyrite, sphalerite, pyrite, galena	Major deposit of 1.35 million tons	Massive and disseminated polymetallic sulfides stratiform mineralization, lenses. Contains over 1.2% Cu, over 2.3% Pb, over 7.6% Zn, over 2.1 g/t Au. It is a high value ore.	2,3,4,5
Knaiguiyah (Area)	Pyrite, chalcopyrite, sphalerite, magnetite hematite	Major deposit of 15 million tons	Volcanosedimentary setting similar to that at Jabal Sayid. Includes four areas of interest. Contains 1% to 5% Cu and 5.8% Zn.	2,4,5
Bir Al-Khays	Chalcopyrite, sphalerite	Major deposit	Similar geologic environment to that of Knaiguiyah. Contains about 1.4% Cu and 0.5% Zn.	2,4,5
Jebel Said	Chalcopyrite, sphalerite, pyrite, pyrrhotite, magnetite	Major deposit of about 20 million tons	Consists of massive mixed sulfides accompanied by gold as well as stringers and lenses of pyrite, pyrrhotite, chalcopyrite. Contains 2% Cu, 1.4% Zn, 0.5 g/t Au, 40 g/t Ag.	2,3,4,5
Al-Massani	Sulfides	Major deposit of 5 million tons	The deposit has been traced intermittently for 5 km in a shear zone of tuffaceous beds and intercalated limestone. Contains 1.5% Cu, 6.3% Zn, 93.3 g/t Ag, 2.8 g/t Au.	2,4,5
Qatam	Mixed sulfides	Major deposit of at least 4.5 million tons	Ancient mining location. The ore contains 2.1% Cu, 0.69% Zn, 6.12 g/t Ag and 0.23 g/t Au. Further information on the deposit was classified confidential. Nickel grades range from .5% to 3%.	2,3,4

(Continued...)

TABLE 8-2: (Continued)

Location	Ore Type	Deposit Size	Comments	Sources
Al-Amar	Gold bearing sulfides	Up to 25 million tons	Massive and disseminated sulfides bearing gold in quartz veins, stringers and zones of silification in volcanosedimentary rocks. Mining will be feasible if zinc smelting operations are carried out in Saudi Arabia. Contains 1 to 11% Zn.	3,4
Red Sea	Geothermal hot brine deposits	Major deposit	Geothermal hot brines rich in dissolved minerals precipitate a variety of minerals on the sea bottom by mechanisms such as simple cooling when contacting the sea water. The formed deposits are rich in sulfides, manganese minerals, gypsum. Three principal formations have been identified as "iron-montmorillonite", "geothite" and "sulfide", with thickness values of the order of a few meters. The deposit contains high grade material.	2

TABLE 8-3: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: LEAD (Pb)

Location	Ore Type	Deposit Size	Comments	Sources
Nuqrah (Area)	Chalcopyrite, sphalerite, pyrite, galena	Major deposit of 1.35 million tons	Massive and disseminated polymetallic sulfides stratiform mineralization, lenses. Contains over 1.2% Cu, over 2.3% Pb, over 7.6% Zn, over 2.1 g/t Au. It is a high value ore.	2,3,4,5
Qatam	Mixed sulfides	Major deposit of at least 4.5 million tons	Ancient mining location. The ore contains 2.1% Cu, 0.69% Zn, 6.12 g/t Ag and 0.23 g/t Au. Further information on the deposit was classified confidential. Nickel grades range from .5% to 3%.	2,4
Red Sea	Geothermal hot brine deposits	Major deposit	Geothermal hot brines rich in dissolved minerals precipitate a variety of minerals on the sea bottom by mechanisms such as simple cooling when contacting the sea water. The formed deposits are rich in sulfides, manganese minerals, gypsum. Three principal formations have been identified as "iron-montmorillonite", "geothite", and "sulfide", with thickness values of the order of a few meters. The deposit contains high grade material.	2,3

TABLE 8-4: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: GOLD (Au) AND SILVER (Ag)

Location	Ore Type	Deposit Size	Comments	Sources
Jebel Said	Mixed sulfides bearing gold and silver	Major deposit of about 20 million tons	Consists of massive mixed sulfides accompanied by gold as well as stringers and lenses of pyrite, pyrrhotite, chalcopyrite. Contains 2% Cu, 1.4% Zn, 0.5 g/t Au, 40 g/t Ag.	2,3,4,5
Mahd Adh Dhahab	Mixed sulfides bearing gold and silver	Major deposit. Veins spread over wide area	Remains of ancient mining operations exist in the area. Gold-bearing quarts veins in large fault zones. Contains 2.15% Cu, 12.5% Zn, 20.8 g/t Au, 140 g/t Ag.	1,2,4,5
Qatam	Mixed sulfides bearing gold and silver	Major deposit of at least 4.5 million tons	Ancient mining location. The ore contains 2.1% Cu, 0.69% Zn, 6.12 g/t Ag and 0.23 g/t Au. Further information on the deposit was classified confidential. Nickel grades range from .5% to 3%.	2,4
Jebel Guyan	Native gold	Major deposit	Reported as major gold deposit.	2
Jebel Umm Matierah	Gold bearing quartz vein	350,000 tons	Contains 7 g/t Au. The remains of numerous ancient mining operations exist in the area.	5
Nuqrah (Area)	Mixed sulfides bearing gold	Major deposit of 1.35 million tons	Massive and disseminated polymetallic sulfides stratiform mineralization, lenses. Contains over 1.2% Cu, over 2.3% Pb, over 7.6% Zn, over 2.1 g/t Au. It is a high value ore.	2,3,4,5
Al-Massani	Sulfides bearing gold and silver	Major deposit of 5 million tons	The deposit has been traced intermittently for 5 km in a shear zone of tuffaceous beds and intercalated limestone. Contains 1.5% Cu, 6.3% Zn, 93.3 g/t Ag, 2.8 g/t Au.	2,4,5

TABLE 8-5: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: IRON (Fe)

Location	Ore Type	Deposit Size	Comments	Sources
Wadi Sawawin	Hematite, jasper	Large deposit of up to 400 million tons	The formation covers an area of 26 km by 2 km and comprises alternating bands, rich in iron oxides and silica. The ore is amenable to magnetic concentrations. Iron content 40%. The reserves are sufficient for major mining operation.	2
Jebel Idsas	Magnetite	Major deposit of 1 to 7 million tons of high grade (55% Fe) magnetite and 300 million tons of lower grade (19% Fe) magnetite and andesite	Consists of bodies of massive magnetite and disseminations in anderites and gabbros. It is one of the major iron deposits of Saudi Arabia. Magnetic concentrates of the ore contain 61% Fe, 0.6% Ti and 0.1 % V.	1,2,4
Wadi Fatima	Oolitic hematite	Over 50 million tons of ore is inferred	The ore deposit is partially explored. Consists of 1 to over 5 m thick oolitic iron oxide deposits extending over a 15 km distance. It is interbedded by other formations such as sandstone and shale. Iron content about 45%.	1,2,4
As-Sarat	Laterite	Major deposit	The ore is rich in silica, alumina and titania. Locally contains as much as 38% iron. Occupies almost 6000 km^2 with thickness of 3 m or less.	1,2
Wadi Wassat	Pyrite, pyrrhotite	Major deposit of 84 million tons	Massive iron sulfide lenses, folded and broken by faults. Contains about 80% sulfide, almost all pyrite. Approximately 47% iron content.	2,4
Jebel Harr	Pyrite	Major deposit	Contains also cobalt and nickel.	2

TABLE 8-6: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: NICKEL (Ni) AND COBALT (Co)

Location	Ore Type	Deposit Size	Comments	Sources
Jebel Harr	Sulfides	Major deposit	Contains cobalt, nickel and pyrite.	2
St. Johns Island (Red Sea)	Not available	Not available	Consists of ore veins in peridotite and other ultrabasic rocks. Contains also platinum and copper.	1

TABLE 8-7: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: CHROMIUM (Cr)

Location	Ore Type	Deposit Size	Comments	Sources
Al-'Ays (Belt)	Chromite	Preliminary estimates give 10,000 tons exposed chromite	The deposit contains 39% chromite and 17% iron in massive lenslike ore bodies, schlieren bodies and disseminated grains in serpentine. Platinum is possibly present as well. Results suggest further deposits available in the area.	1
Hamdah (Belt)			Possible source of chromite.	1

TABLE 8-8: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: TITANIUM (Ti)

Location	Ore Type	Deposit Size	Comments	Sources
Red Sea Coast	Placers of ilmenite		The Oahrnah placer contains 20,000 tons of strongly magnetic mixture of magnetite and ilmenite. Titanium analysis not available.	1
Al-Qunfudhah	Titaniferous magnetite	500 m wide by 1500 m long	Titaniferous magnetite is concentrated in the pyroxenitic core of a pluton intrusion. Average content of TiO_2 in drill cores is 16.5% (8% to 30%). Surface samples indicated 45% Fe content.	3
Lakathah	Titaniferous magnetite		The formation consists of a layered gabbro intrusion of about 10 km in diameter. Samples indicate 6.2% Ti and 32% Fe content.	2,4

TABLE 8-9: METALLIC MINERAL RESOURCES OP SAUDI ARABIA: ZIRCONIUM (Zr), THORIUM (Th), AND URANIUM (U)

Location	Ore Type	Deposit Size	Comments	Sources
Jebel Said	Complex minerals associated with peralcalic granite	Not available	Contains as much as 1% Th, 0.5% cerium and 1% yttrium. The ore contains a mixture of rare earths.	1
Jebel Tawlah	Microgranite	Not available	Consists of granitic plutons enriched in niobium, yttrium, thorium, uranium and zirconium. Zircon and the associated minerals occur as a fine grained aggregate along fracture planes. Contains 3000 ppm Ta, 600 ppm Sn, 36 ppm U, 900 ppm Th, 6000 ppm Y, 37% Zr and 0.3% Zn. The formation has not been studied enough.	2,4
Ghurayyah	Complex minerals	Major deposit of the order of 400 million tons	Consists of granitic plutons enriched in columbium, rare earths, thorium, uranium. Contains 0.75% Zr, 0.25% combined Nb-Ta, 0.1% Y, 0.25% rare earths, 0.0115% U and 0.02% Sn. Reasonable recoveries for some of these metals are possible.	2,4

TABLE 8-10: METALLIC MINERAL RESOURCES OF SAUDI ARABIA: ALUMINUM (AL)

Location	Ore Type	Deposit Size	Comments	Sources
Az-Zabirah	Pisolitic bauxite (boehmite and gibbsite)	Major deposit	It is an extensive layer of fossil bauxite extending over an area of almost 200 km^2 with an average thickness of about 2 m. Average alumina content is 41%. Multiple pisolitic layers are present in some places. The thickness of the layer locally exceeds 5 m.	2,4,5
Al-Abidiyah	High alumina clays	8 million m^3	The deposit consists of yellow laterite and white saprolite and averages 28% alumina (Al_2O_3).	2,4

TABLE 8-11: METALLIC MINERAL RESOURCES OF OMAN: CHROMIUM (Cr)

Location	Ore Type	Deposit Size	Comments	Sources
Farfar	Chromite	Over 200,00 tons	Comprises 5 separate bodies spread over an area less than 1 km^2. The ore has a low content of Cr_2O_3 (25% to 36%) and high iron content. The complex chemical composition of the ore and the location of the deposit in a particularly inaccessible part of the mountains render the economic value of the deposit unclear.	3
Jinah	Chromite	About 20,000 tons	Small deposit of chromite of the podiform type. The deposit is easily accessible but rather low grade (39% Cr_2O_3). Both the Jinah and Farfar deposits are associated with the large ophiolitic belt that extends over 600 km along the north-eastern coast, probably into the UAE. Further deposits of chromite may bring total reserves to about 20 million tons.	3,6

TABLE 8-12: METALLIC MINERAL RESOURCES OF OMAN: COPPER (Cu)

Location	Ore Type	Deposit Size	Comments	Sources
Sohar	Chalcopyrite, sphalerite	12 million tons	The deposit consists of three ore bodies with 2.1% Cu content. Under commercial exploration with a starting capacity of 100,000 tons a year.	3
Tawi Ubailah	Brachantite	250,000 tons	It is a low grade deposit of up to 0.73% Cu. The mineralized zone occurs in gabbro and its contact with sheared serpentine.	3

TABLE 8-13: COMBINED METALLIC MINERAL RESOURCES OF THE GCC REGION

Element of Interest	Ore Type	Deposit Size	Comments
Copper (Cu)	Mainly copper sulfides	Over 78 million tons	Deposits are concentrated in Saudi Arabia (over 96% of total) and in Oman (Sohar area over 1.5% of total reported). Commercial exploitation of copper ore, including smelting, currently takes place in Oman. Copper content ranges from 0.5% to 2.15%, usually containing over 1% copper with total copper reserves exceeding 23 million tons of pure metal.
Zinc (Zn)	Mainly zinc sulfides	Over 70 million tons	Deposits located mainly in Saudi Arabia. Zinc content ranges from 1.4% to 12.5% with total pure metal reserves exceeding 2.4 million tons.
Lead (Pb)	Mainly lead sulfide	Over 6 million tons	Deposits are located mainly in Saudi Arabia with total pure metal reserves over 50,000 tons.
Iron (Fe)	Mainly magnetite and pyrite	Over 834 million tons	Deposits are concentrated in Saudi Arabia with iron content ranging from 19% to 61%. Total pure metal reserves estimated to be over 282 million tons.
Chromium (Cr)	Chromite	Over 230,000 tons	Mainly concentrated in Oman with chromium content ranging from 25% to 39% as Cr_2O_3.
Zirconium (Zr) Thorium (Th) Uranium (U)	Complex minerals	Over 400 million tons	Located in Saudi Arabia, with zircon content ranging from 0.75% to 3.7%, thorium from 0.1% to 1%, and uranium from 0.36% to 0.0115%.

(Continued...)

TABLE 8-13: (Continued)

Element of Interest	Ore Type	Deposit Size	Comments
Aluminum (Al)	Bauxite	About 400 million m^3 of ore	Located in Saudi Arabia with an average alumina content of 41%. High alumina clays also present.
Gold (Au)	Native gold	Over 26 million tons	Deposits are concentrated mainly in Saudi Arabia with gold content ranging from 0.23 g/t to 20.8 g/t gold. Total pure metal reserves estimated to be well over 800,000 ounces.
Silver (Ag)	Native silver	Over 26 million tons	Deposits are concentrated mainly in Saudi Arabia with silver content ranging from 2.45 g/t h to 140 g/t silver. Total pure metal reserves estimated to be well over 50 million ounces.

TABLE 8-14: SUMMARY OF INDUSTRIES RELATED TO METALLIC MINERAL RESOURCES PROCESSING IN THE GCC REGION

	Aluminum	Iron	Copper
Bahrain	- Smelting plant. 170,000 tn/a. Operating.	- Iron ore pelletizing plant. 2,000,000 tn/a. Under construction. - Specialty steel plant. Under study.	-
Kuwait	- Participant in joint project, 40,000 tn/a smelting plant in Bahrain. - Small scale extrusion plants. Operating.	- Sponge iron plant. Prefeasibility study undertaken.	-
Oman	-	- Integrated steel plant. 150,000 tn/a. Under construction. - Expansion of steel plant to 330,000 tn/a. Under study.	- Copper ore smelting plant. 20,000 tn/a. Operating. - Copper electrolytic refinery plant. 20,000 tn/a. Plan adopted by government.
Qatar	-	- Iron processing plant. 440,000 tn/a. Operating. - Expansion of iron plant to double capacity. Under study.	-
Saudi Arabia	-	- Steel rolling plant. 140,000 tn/a. Operating. - Integrated sponge iron-steel plant. 800,000 tn/a. To be built.	-
UAE	- Smelting plant. 130,000 tn/a. Operating.	- Steel rolling plant. 45,000 tn/a. Operating. - Integrated steel plant. 500,000 to 800,000 tn/a. Under consideration.	-

NOTE: tn/a stands for tons per annum.

CHAPTER 9

NON-METALLIC MINERALS

9-1. OCCURRENCE OF NON-METALLIC MINERAL RESOURCES

Non-metallic mineral resources can be subdivided into two general categories. The first consists of the industrial minerals such as limestone, magnesite, clay, etc. The second category comprises the various types of ornamental stone, such as marble or granite. Production of ornamental stone and of various other types of non-metallic minerals is also referred to as quarrying when it takes place by open pit mining techniques.

Unlike metallic mineral resources, non-metallic mineral resources are distributed over the whole of the GCC region; they are not confined, in terms of their mineralization, to the Arabian Shield area. Excluding oil and gas, which are the subject of Chapter 7, the principal non-metallic mineral resources of the region are its substantial deposits of phosphates, anhydrite, clay, marble, limestone and igneous rock. Phosphate deposits of significant value are located in Upper Cretaceous and Paleogene sediments. Gypsum and anhydrite occur in a wide range of the geological sequence, from Permian to Neogen. Clay deposits are also present in a wide range of the geological sequence. Marble, limestone, and cement industry raw materials are associated with the Upper part of Phanerozoic sections. (Reference 2).

The present chapter attempts to compile an inventory of the non-metallic mineral resources of the GCC region. The inventory is presented in a format similar to the one used in Chapter 8 for metallic mineral resources.

To date, the state of Bahrain has not identified significant mineral resources.

In the state of Kuwait, the available non-mineral resources are of the construction materials type, such as clays, gravel, sand, and limestone, with part of the available limestone being of quality suitable for cement manufacturing. In general, Kuwait is covered by surface and near surface sedimentary rocks of Cenozoic age which form the most important sources and potential sources of construction materials. The exposed beds are usually horizontal to subhorizontal, with lithification and cementation varying from place to place. The existing cement production capacity stands at 1.425 million tons per year. (Reference 15).

Oman occupies the south-eastern part of the Arabian peninsula, and in terms of basic geology it comprises a substantial part of the basement outcrop that surfaces at this part of the peninsula. Oman has identified both metallic and non-metallic mineral resources and has undertaken active exploitation of both. A cement manufacturing complex is under construction which will use partly materials from local quarrying operations. Plans exist for the manufacturing of fertilizers as well.

In its basic geology, the Qatar peninsula is part of the Arabian Shelf. The depth of the sedimentary succession overlaying the basement in Qatar has been estimated to be over 10 km. The oldest strata exposed on the Qatar peninsula are limestones and dolomites of the Rus formation. This sequence contains, in some parts, gypsum and anhydrite that have been eroded by desolution, resulting in collapsed structures at the surface. Following the Rus formation is the Dammam formation, with limestones and shale. The lagoonal and marine sediments of the Dam formation unconformably overlie the Dammam formation. Younger Hofuf formation sands and gravels exist as cappings on top of the Dam formation masses and as redeposited masses on limestone. Qatar has identified some non-metallic mineral resources within its territory.

Saudi Arabia dominates the GCC region in terms of geographical size and contains within its territory areas of the two principal geological environments of the Arabian Peninsula, namely the Arabian Shield and the Arabian Shelf. The country contains substantial deposits of the non-metallic mineral resources that are to be found in the region; indeed, it accounts for the bulk of the region's non-metallic mineral resources.

The United Arab Emirates occupy a coastal part of the Arabian peninsula between Qatar and Oman. In terms of geological environments, the Emirates contain part of the crystalline basement outcrop, which continues into Oman, and also parts of the sedimentary formations of the Arabian Shelf. A comprehensive study of mineral resources has been initiated by the UAE, but results of the study were not available for use in this report. Fragmentary data compiled previously indicate the presence of significant non-metallic resources.

The entries in the tables for Saudi Arabia that accompany this chapter are based on the 1982 non-metallic mineral resources locality map of the Deputy Ministry of Mineral Resources of the Kingdom. Only potential economic deposits and major quarries are listed. The classification used is the one proposed by the Deputy Ministry of Mineral Resources. Similarly, only deposits reported in the respective publications of the other GCC countries are listed in the tables. Wherever possible, the information presented in the tables was cross-checked, using more than one reference.

9-2. RESOURCES INVENTORY

Tables 9-1 to 9-21 present an inventory of the significant non-metallic mineral resources of the GCC member states separately for each type of resource and for each state, as well as for the GCC region as a whole. The tables list the more significant industrial minerals first, followed by the minerals used primarily in construction, and finally by the less significant non-metallic mineral resources.

9-3. COMMENTS ON NON-METALLIC MINERAL RESOURCES

As noted previously, Bahrain does not possess significant non-metallic mineral resources. However, some brick-making plants have been established in recent years. Also, a 400,000 tons per year cement production capacity exists, and plans call for an expansion to 1,000,000 tons per year.

In Kuwait, apart from salt, which is produced by solar evaporation of sea water, and sulfur, produced as a by-product of oil and gas processing, the only mineral products are of the construction materials type. There are about 48 quarries in production with an approximate total annual output of sand and gravel close to 2 million cubic meters. Limestone is also quarried for use as filler and for sand-lime brick manufacturing. About 1.5 million bricks are produced daily. The cement factory at Shuaiba, with a capacity planned to rise from 1.425 to 2 million tons per year, is using imported raw materials. Some mining potential for use by the cement industry exists for the lime rich portion of the oolitic limestone that has been found south of Kuwait City. Expansion in the production of sand and gravel is a possibility. (Reference 10).

Oman presents a favourable and diverse geological environment. A cement plant of 600,000 tons per year capacity is planned to go into production at Rusail. Raw materials, including gypsum and silica are available locally. Bauxite will be imported. (Reference 16). A cement works in Muskat, built as a joint project with Kuwait, will have a capacity of 350,000 tons per year. (Reference 8). Magnesite mineralization, with up to 87.4 percent M_gCO_3 content, has been reported but additional information is not available. Evidence is also available that Oman possesses substantial exploitable marble deposits. Production could be up to 4 million cubic meters of marble per year. (Reference 2).

Non-metallic minerals are the only mineral resources currently extracted in Qatar. (Oil and gas are not considered here; they have been dealt with in Chapter 7). Limestone is quarried for use in construction. Sand is also extracted, some of it washed free of gypsum at a newly established plant, and used in the building industry. A cement plant with a newly increased capacity of 330,000 tons per year at Umm Bab is using locally produced chalky limestone, calcareous clay, and crystalline gypsum. Moreover, plans to increase the cement production capacity by 1 million tons per year are under consideration. Newly discovered gypsum deposits have expanded the gypsum mining potential. Celestite deposits have also been identified, but are of no economic significance. Attapulgite clays/shales have been located and could form the basis for the establishment of an industry for their production and export (Reference 7). Furthermore, available clay deposits can sustain cement manufacturing, and could be used for brick-making as well. Saline water from Zekrit Bay may also be used to produce, by solar evaporation, significant quantities of inorganic chemicals, such as sodium chloride and bromine. The production of these basic chemicals might provide the basis for the establishment of a chemical complex producing subsequent generations of inorganic chemicals, such as sodium bromide, sodium carbonate, sodium hydroxide, and others suitable for internal use and perhaps export.

Saudi Arabia possesses a substantial wealth of non-metallic mineral resources. The available extensive gypsum deposits can be used to support the Saudi Arabian cement industry, which by 1978 had an estimated production of 1.791 million tons but was able to satisfy only 21.1 percent of the total demand. The cement plant capacity of the country is planned to increase to 36.4 thousand tons per day by 1985, according to the Saudi Arabian Third Development Plan. (Reference 17). Large deposits of pure limestone are also available to support the cement and building industries. Clay deposits of good quality have been identified too, suitable for the manufacturing of direct clay and building products. Substantial deposits of silica-rich sand are available, suitable for glass manufacturing. Calcarous phosphorite deposits could be developed for the production of phosphoric acid, phosphates, and fertilizer, provided some difficulties associated with the mining and beneficiation of the ore can be overcome. Attention should be given to the possible presence of low levels of uranium in the phosphate rocks. The presence of uranium and the associated radium-radon radionuclides necessitates certain precautions during mining and waste disposal, while at the same time the application of new separation technology could recover the available uranium from the leach wastes. Extensive reserves of ornamental stone are also available, ranging from excellent to fair quality, including marble and granite. Mining and processing activities are already underway and there is substantial potential for expansion. (The products of these activities could replace imported ornamental stone in the region.) Sulfur is also available in abundant supply, mainly as a by-product of oil and gas processing. The production of sulfuric acid is therefore possible, for use by other sectors, such as phosphate rock processing. Other possible resources are magnesite, suitable for the manufacturing of products such as fire resistant blocks, and salt extracted from sea water by solar evaporation that could support further "downstream" inorganic chemical industries, such as caustic soda production. Caustic soda could be used to process bauxite for the production of alumina, so that an integrated regional aluminum industry could be established in collaboration with already existing aluminum smelting plants (in Bahrain and the UAE). The availability of abundant energy, capital, and transportation facilities will assist the development of the resources.

In the United Arab Emirates, the non-metallic mineral sector has increased greatly in importance, with an annual growth rate in the 1972-77 period of 48 percent. Data available at the end of 1974 indicated limestone reserves of over 200 million tons of a quality suitable for cement manufacturing. Cement plants are located throughout the Emirates, and the 1978 national production was estimated at 1.5 million tons. (Reference 8). Estimates available indicate that the 1982 capacity was 3.1 million tons per year, with plans for a further 2.67 million tons per year now being implemented. (Reference 15). Lime could also be used to expand production of other building products, such as sand-lime bricks. The practically unlimited quantity of sand available can be used to produce building materials such as concrete blocks, prefabricated panels, etc. The gypsum needed for the cement and construction industries can also be obtained locally from the available reserves. Gypsum consumption was estimated to be around 200,000 tons in 1980, and this level of demand could be met by mining locally available reserves. (Reference 13). Large reserves of good quality marble suitable for use as ornamental stone by the building industry exist in Ajman and Ras Al-Khaima. The marble is available in a variety of colours and could be used to expand the quarrying and processing industries, with a view to both satisfying domestic demand and providing a supply for export to other countries of the GCC region. In planning further development in this regard, and in view of the shortage of labour in the UAE, the use of capital-intensive, labour-saving technology would be appropriate.

The non-metallic mineral sector has developed rapidly in the GCC region as a whole, and the existing resources are sufficient to support a substantial degree of regional industrialization which could assist such industries as construction and industrial chemicals. The development of the sector on a cooperative basis within the region would help to avoid duplication of effort, while at the same time making the sector more viable by securing a larger regional market.

9-4. BRIEF OVERVIEW

The information presented in Tables 9-1 to 9-21 suggests clearly that the non-metallic mineral resources of the GCC region are more widely distributed among the member states, as compared to the geographically concentrated metallic mineral resources discussed in Chapter 8. Furthermore, the size of the reserves for some of these resources is large. The available large reserves of gypsum, limestone, and clay could successfully supply the regional cement industry, which has a present operating capacity of the order of 7.3 million tons per year and for which plans exist to increase capacity significantly. The increase in the utilization of regional raw materials by the cement industry will allow a reduction of imports of raw materials, and the projected increase in cement output will assist in reducing the volume of imported cement.

Extensive reserves of sand and gravel can be mined and used to supply the construction sector, while high quality quartz sand available in Saudi Arabia could support a glass manufacturing industry. The large reserves of ornamental stone, both marble and granite, could be used successfully to substitute for imported materials. Saudi Arabia is currently operating ornamental stone model quarries and processing plants in an attempt to promote utilization of local stone by the construction industry. These efforts could be extended throughout the region as a whole.

The calcareous phosphate deposits in Saudi Arabia could form the basis for the establishment of regional phosphate, phosphoric acid, and fertilizer industries. Sulfuric acid could be produced from the sulfur associated with the abundant reserves of oil and natural gas, and natural gas could also be used as a fuel in the process. Fertilizer plants could use ammonia produced in the region. The extensive phosphate reserves of the Eastern Mediterranean Phosphate Basin and the associated chemical industries that exist in neighbouring countries (e.g., Jordan) should be taken into account in development planning.

The available high salinity sea water, and the extensive rock salt deposits in the region, could be used to support an inorganic chemical complex that could produce chemicals such as caustic soda (useful in alumina refining), magnesia, and magnesium.

The expansion of industrial activities related to the available non-metallic mineral resources of the GCC region appears feasible and could increase substantially the levels of production and income in the non-oil sector of the region. This expansion could be supported to a large extent by the more intensive exploitation of existing resources.

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TABLE 9-1: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: GYPSUM, ANHYDRIDE

Location	Ore Type	Deposit Size	Comments	Sources
Jebel Raghamah (Area)	Gypsum	Not available	Potential economic deposit.	1
Tuwayyil Al-Kibirt (South)	Pure gypsum	Very large deposits	Gypsum beds several hundred meters thick are exposed in the area and could be used for a virtually unlimited supply of very pure gypsum. The deposit is very close to the sea (15 km). Sulphur is also present in the area.	1, 2, 3
Sharm Mahar	Gypsum	Not available	Potential economic deposit.	1
Khashm Umm Huwayd	Gypsum	5 million tons	Very pure gypsum deposit containing 96% gypsum. Possible economic deposit located on the Arabian Gulf coast.	1, 3, 2
Sharm Al-Khawr	Gypsum	Not available	Potential economic deposit.	1
Yanbu (North)	Gypsum	Not available	Potential economic deposit located on the Red Sea coast.	1
Maraghah	Gypsum	Up to 15 million tons	Consists of 10 to 15 m thick gypsum beds exposed. A second deposit of almost 3 million tons 83 to 92% gypsum in the form of gyprock is located near the area. The deposits are near the government railroad tracks.	1, 2

TABLE 9-2: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: LIMESTONE

Location	Ore Type	Deposit Size	Comments	Sources
Al-Kharj (Area)	Limestone	Very large	Limestone is in abundant supply in central and eastern Arabia. This Aruma limestone is fine grained. Contains 54.6% lime, 0.4% alumina, 0.4% silica, 0.18% ferric oxide and is of good quality. It could be mined in areas designated as potential economic deposits such as Wadi Hanifah, Mugharrizat south, Umm al Ghirban.	1, 3, 4
Huraysan	Dolomite	Potential economic deposit	Near the railroad tracks southeast of Riyadh.	1
Al-Hufuf	Limestone	Large	Large deposits of pure limestone containing almost 55% lime and 2.4% magnesia. Areas designated as potential economic deposits near Al Hufuf are at Al Jadidah, Barga Rukban, At Tamatayn. Suitable for cement manufacturing.	1, 3, 4
Kharsaniyah	Limestone	Over 80 million tons	Near the Arabian Gulf coast north of Jubayl. It is poor in magnesia with maximum thickness of about 9 m. The outcrop is divided in three sections, only the central one being suitable for cement manufacturing. It is a potential economic deposit.	1, 4
Wadi Ad-Najabiyah	Limestone	5 billion tons	Cropping out without overburden. The deposit displays a massive structure and is 42 m thick. It is poor in magnesia (less than 1.3% M_gO), but rich in silica. Useful as raw material for the cement and building industries.	1, 5

(Continued...)

TABLE 9-2: (Continued...)

Location	Ore Type	Deposit Size	Comments	Sources
Red Sea Coast	Limestone	Over 15 million tons	Reef limestone of coral origin exists at several locations along the Red Sea coast. Deposits of potential economic significance are found at the Ras Baridi, Sharm Rabigh, south Jeddah and Farasan Al Kabir south areas. It is suitable for metallurgical flux also.	1, 3, 4
Umm Araj	Limestone	Over 40 million tons	Good quality Jurassic limestone suitable for cement manufacturing. Half of the reserves are in one deposit, the balance in the form of limestone ridges east of Umm Araj.	1, 4

TABLE 9-3: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: CLAY

Location	Ore Type	Deposit Size	Comments	Sources
Wadi Qarrah (Area)	Clay (structural)	Over 21.8 million tons	A bed of clay more than 2 m thick exists under 1 m of sand and gravel. Three zones have been mapped with minimum reserves exceeding 6 million tons each. Suitable for brick manufacturing.	1, 3, 4
Marah Safra Aludi An-Nuqayah Khasm Qaradan (West)	Clay (structural, expanded)	Large	Potential economic deposits. Near Durma, the Durma-Marrat clay-shale deposit is over 40 km long with a regular thickness of 58 m and an overburden ratio less than 1:10 in certain places. This clay is suitable for the manufacturing of prime quality fired clay products.	1, 4
Darb Sid	Clay (ceramic)	Potential economic deposit	Near Riyadh contains clay suitable for ceramics.	
Wadi Sallah	Kaolinitic clay	Over 50 million tons	The deposit consists of clay beds separated by sandcoke or sandy limestone under thin overburden. The upper clay bed is the thickest and extends over 6 km. Aggregate clay thickness of 14.2 m of which 9.1 m belong to the upper bed. The clay is suitable for manufacturing structural clay products, and possibly for the manufacture of ceramics as well.	1, 4
Khushaym Radi	Kaolinitic clay	Large deposit	Consist of three clay beds with a limestone overburden. Exploitation of upper layer depends on the value of the overlaying limestone. The intermediate layer can only be used as cleanser. The lower layer is the most accessibly exposed but its thickness has been reduced by errosion. The clay deposits belong to the Wasia formation.	1, 4

(Continued...)

TABLE 9-3: (Continued...)

Location	Ore Type	Deposit Size	Comments	Sources
Al-Haydaruk	Clay (structural)	Potential economic deposit	Comprises two clay layers each about 5 m thick, separated by a poorly consolidated sandstone bed. The layers are continuous and homogenious but the top of the upper layer is rich in soluble salts. The lower clay bed could be used for brick manufacturing and the intermediate sandy bed could be used as filler. The upper layer, being contaminated with soluble salts, is not likely to find use in industry.	1, 4
Al-Lidam	Clay (structural)	About 12 million tons	Consists of two clay layers with combined thickness of 8 m separated by 1 to 3 m of sandstone. Both layers are similar but the overburden is thick. The intercalated sandstone is suitable for use as filler. Both clay layers meet quality standards for automatic manufacturing of bricks.	1. 4
Al-Harrah and Jebel Muhaysiniah	Clay (structural, expanded)	Large	The clays between Usfan and Khulays are uniform laterally over considerable distances except for local disruptions due to faulting. In general red-brown silty clays alternate with tan sandy clays. The darker clays, when fired, develop hardness greater than steel. The addition of the lighter material improves the drying characteristics.	1, 4

TABLE 9-4: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: PHOSPHATE

Location	Ore Type	Deposit Size	Comments	Sources
Thaniyat Turayf	Mixed calcareous siliceous phosphorite	Over 190 million tons	Two phosphorite beds, the first 0.1 m to 1 m thick, the second 1 m to 2.5 m thick. They are separated by a 1.65 m barren material layer. The deposit covers an area of 50 km^2 with an average grade of 23% P_2O_5. Beneficiation of the ore is not easy. The ore could be used for the production of phosphoric acid, phosphates or fertilizer. Open pit mining is not economical. The limestone overburden is 26 m to 100 m thick. The deposit is not close to the sea.	1, 2, 3, 4, 5, 9
Sirhan Turayf	Calcareous phosphorite	About 722.2 million tons	Three phosphorite beds of 0.25 m to over 3 m thick, extending over a 78.5 km^2 area averaging 18% P_2O_5. The ore is virtually free of silica and clay. Beneficiation of the ore is not easy. Water availability, fuel cost and ore behaviour will determine mining potential. Phosphate deposits usually contain low levels of uranium. Uranium could be potentially recovered from phosphate rock using advanced separation/recovery technology.	1, 2, 3, 4, 5, 9

TABLE 9-5: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: GLASS SAND

Location	Ore Type	Deposit Size	Comments	Sources
Al-Kharj	Quartz sand	Large	Two deposits, the Wasia and Biyadh sandstone are located near Riyadh. They contain high quality quartz sand suitable for use in glass manufacturing and located close to the railroad. The Wasia formation is up to 25 feet thick and runs over a few kilometers. The Biyadh formation is about 7 feet thick, outcropping also for several kilometers. They contain 99% silica. The -20+100 mesh size contains almost 98% of total mass.	1, 3, 4
Arabian Gulf	Silica sand	Large	Dunes along the Arabian Gulf can be used as the source for large quantities of silica sand for glass manufacturing. Silica content is over 97.4% with 0.61% iron. They contain 96% of total mass in the -10+150 mesh size. Potential areas are at Al-Khubar, Daha, Dhalum and Abqaiq.	1, 3, 4

TABLE 9-6: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: ORNAMENTAL STONE

Location	Ore Type	Deposit Size	Comments	Sources
Yanbu	Anorthosite granite	Major quarry	A model quarry was maintained at this location to provide demonstration of good quarrying practice and samples for display in exhibitions and for use in buildings.	1, 4
Zafrana, Wadi Al-Qazaz, As-Sidarah, Wadi Hubt	Igneous rock	Major quarries	There is also a large number of minor quarries. The reserves of various types of igneous rock are large. The government is promoting the processing and use of local stone operations, also model cutting and processing facilities.	1
Al-Jumum	Pink granite	Medium reserves	Good quality granite where a model quarry is operated by the Deputy Ministry of Mineral Resources.	1, 5
Wadi Arran	Grey granite and marble	Medium reserves	Good quality granite. Model quarry of the Deputy Ministry of Mineral Resources.	1, 5
Bir Askar	Brown granite	Large reserves	Exceptional quality granite. Model quarry of the Deputy Ministry of Mineral Resources.	1, 5
An-Najuf	Red granite	Large reserves	Exceptional quality granite. Model quarry of the Deputy Ministry of Mineral Resources.	1, 5
Wadi Naman Talhah (Al-Humrah)	Igneous rock	Major quarries		1
Zafrana (south) Jebel Darhafah Bir Ibn Husani Jebel Sumran Sulaym Bahrah (southwest) Jebel As-Sagar	Marble	Major quarries	A number of deposits have been and are being exploited for marble in Saudi Arabia. There is substantial volume of good quality marble in the country and many quarries, some of which have been operated intermittently.	1, 2

(Continued...)

TABLE 9-6: (Continued...)

Location	Ore Type	Deposit Size	Comments	Sources
Jebel Farsan	Marble	Major quarry	Consists of group of hills as high as 600 m above sea level. The marble varies from white, whitish marbled or veined to light grey with some dark grey to black. It is somewhat silicious and fractured. Accessible by road from Jeddah. It has already been mined.	1, 2, 4
Al-Muza Himiyah Ar-Riyadh (south) Wadi Hanifah Jebel An	Limestone	Major quarries	Limestone, when pure, occurs in a variety of colors and is suitable for use as an ornamental stone for construction.	1, 4

TABLE 9-7: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: SULFUR

Location	Ore Type	Deposit Size	Comments	Sources
Tuwayyl Al-Kibirt (south)	Pure gypsum with native sulfur.	Very large	See listing of the same deposit under gypsum. Native sulfur occurrences have been noticed in gypsum beds of Neogen age along the Red Sea coast.	1, 2, 3
Wadi Wassat	Massive pyrite	640 million tons	Preliminary evidence has shown 78% pyrite content. This pyrite can be used as a source of sulfur.	2
Natural gas fields	Hydrogen sulfide	Very large	The greatest present potential source of sulfur in Saudi Arabia. Natural gas contains 2-6% hydrogen sulfide. About 80 tons of sulfur could be recovered per million cubic feet of gas.	1, 3

TABLE 9-8: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: MAGNESITE

Location	Ore Type	Deposit Size	Comments	Sources
Zarghat	Magnesite	Several million tons	The deposit consists of lenses of magnesite of a synclinical structure that bottom a short distance below plain level. Contains good grade magnesite with 96% $MgCO_3$ and less than 2% SiO_2.	1, 2, 3
Jebel Ar-Rakham	Magnesite	Up to 40 million tons	The deposit contains up to 12 million tons of high grade ore of over 90% magnesite and additional tonnage of lower grade ore. Not far from Mahd Adh Dhahab. The deposit is a hydrothermal replacement of dolomite by magnesite. Throughout the mapped area the deposit has a thickness of 100 m and is massive and blocky. Levels of calcium are low (1.2% to 2.4% as CaO).	1, 2, 3

TABLE 9-9: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: SODIUM SALTS

Location	Ore Type	Deposit Size	Comments	Sources
Jizan	Rock salt	Possibly over 1 billion tons	The deposit underlies a hill 1.5 x 3 km. The average grade for the 16 million m^3 deposit is 96% NaCl, 1.5% $CaSO_4$, 2.1% undissolved residue of clay salt and quartz grains.	1, 2, 3
Gulf of Garnet	Sea water	Very large	Sodium chloride can be extracted from sea water following evaporation of the water on pans using solar energy. Salt can be produced this way from sea water in general.	2, 3

TABLE 9-10: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: VOLCANIC CINDER

Location	Ore Type	Deposit Size	Comments	Sources
Harrat Lunayyir (North)	Volcanic cinder	Potential economic deposit	Fragmental debris from igneous and metamorphic rocks can be used for road construction and concrete aggregate.	1, 3
Jebel Hayil	Volcanic cinder	Potential economic deposit	It is situated close to the Red Sea coast and road facilities.	1, 3

TABLE 9-11: NON-METALLIC MINERAL RESOURCES OF SAUDI ARABIA: FELDSPAR

Location	Ore Type	Deposit Size	Comments	Sources
Ar-Ruwaydah	Feldspar	Potential economic deposit	Granite pegmatites rich in feldspar are common in the Arabian Shield.	1, 3

TABLE 9-12: NON-METALLIC MINERAL RESOURCES OF KUWAIT: LIMESTONE

Location	Ore Type	Deposit Size	Comments	Sources
Ahmadi	Limestone	Large	The deposit consists of a ridge of limestone bedrock of the Dammam formation. The exposed portion of the formation includes two limestone units. The upper is 4 m to 5 m thick, harder, and consists of greyish, stratified, slightly dolomitic, siliceous limestone. The lower unit is white, porous dolomitic limestone. It is presently being exploited.	6
100 km South of Kuwait City	Oolitic limestone	195 million tons	The deposit consists of an upper zone of oolitic limestone and a lower zone of oolitic sand. The upper is generally richer in lime (over 75%) than the lower zone. Impurities increase with depth. About 25% of the deposit is lime rich. The lime rich portion could be used for cement manufacturing. The deposit lies partly below the water table and can be served by the Kuwait-Khafji Highway.	6

TABLE 9-13: NON-METALLIC MINERAL RESOURCES OF KUWAIT: SAND

Location	Ore Type	Deposit Size	Comments	Sources
100 km South of Al-Jara	Sand	5 million m^3	The deposit has not been developed yet. The sand is coarse to fine. The finer content ranges from 3% to over 10%. Finer content decreases with depth. The deposit has an approximate thickness of 4 to 7 m. Silica content is 78% SO_2. Access to the deposit is excellent. The sand is suitable for use as construction material.	6
96 km South of Al-Jara	Sand	0.5 million m^3	Situated close to the previous entry the deposit contains uniform gradation sand, medium to fine with an exploitable deposit thickness of 1.5 to 2.8 m minimum. It has not been developed yet. The sand is suitable for use as construction material.	6
Al-Jara (Area)	Sand	13 million m^3	Coarse to find sand. Silica content is 88% as SiO_2 and the finer content ranges from 2% to 24% consisting primarily of silt and clay in the form of lumps and coatings. The sand is suitable for use as construction material. The area is currently being quarried for sand.	6
Umm Nega and Neutral Zone	Sand	Large	These are recent formations of aeolian sand that is concentrated in the form of dunes. The sand is white to brown, fine to coarse and consists of quartz grains. Impurities are in the form of ferric oxide, calcite, gypsum and mica.	6

TABLE 9-14: NON-METALLIC MINERAL RESOURCES OF KUWAIT: CLAY

Location	Ore Type	Deposit Size	Comments	Sources
Warba Island Babiyan Island Khor Al-Sabiyah	Clay	Large	Sandy and silty clays with high content of gypsum and shell debris are exposed on and underlie these areas. They represent deposits of the Euphrates-Tigris delta. The potential uses of this clay are not clear because of the quality of the material. The exploitable thickness of the Babiyan Island deposit ranges from 1.2 m to 2 m under a 1 m to 1.8 m overburden.	6

TABLE 9-15: NON-METALLIC MINERAL RESOURCES OF KUWAIT: GRAVEL

Location	Ore Type	Deposit Size	Comments	Sources
West of Basrah Highway (Al-Jahra)	Gravel	9.7 million m^3	Comprises 15 locations of commercially exploitable gravel beds. They belong to the Dibdibba formation. The thickness of the overburden (material with less than 20% gravel) averages 1 m or less. The exploitable deposit ranges from 0.5 to 3 m thickness. The gravel is cemented by calcite and gypsum, the degree of cementation increasing towards the bottom. Maximum gravel size up to 3 inches. The finer are silt calcite gypsum and clay.	6
East of Basrah Highway	Gravel	0.7 million m^3	Comprises three more locations of commercially exploitable gravel of the same type as described in the previous entry.	6

TABLE 9-16: NON-METALLIC MINERAL RESOURCES OF QATAR: GYPSUM

Location	Ore Type	Deposit Size	Comments	Sources
An-Nafkhah	Gypsum	3 million tons	The deposit is currently being exploited and supplies the Umm Bab cement plant. The deposit has reserves of approximately 2 million tons. Additional reserves of some 1 million tons have been identified at Nagsh mesa near An-Nafkhah. The southern portion of this area contains up to 9 individual beds ranging in thickness from 0.1 m to 1.5 m.	7
Saub As-Salamah	Gypsum	9 million tons	A possibly large gypsum deposit located near the southern border of the state with a thickness of at least 1 m at outcrop. There is a possible 5 million tons of gypsum at the surface with an additional inferred 4 million tons under a thin sand cover. Other gypsum layers are believed to underlie the surface layers. These reserves might sustain a local industry.	7
Southern Qatar	Gypsum	Not available	Deep exploratory boreholes have identified massive gypsum layers in horizons lying at depth in the Rus formation. The presence of this gypsum may have caused the crater-like depressions of the surface after local dissolution of the gypsum layer and roof collapse of the cavities that were formed. The deposit occurs at a depth of 30 m or more and extends over a large area.	7

TABLE 9-17: NON-METALLIC MINERAL RESOURCES OF QATAR: CLAY

Location	Ore Type	Deposit Size	Comments	Sources
Sauda Nathil (Area) Dukhan	Attapulgite clay	Large	The deposit belongs to the Midra shales of the Dammam formation that occur under most of the southern part of the Qatar peninsula, outcropping at those two main areas. Consists mainly of yellowish-brownish attapulgite clays with numerous fossils and, particularly in the Dukhan area, clusters of limonite pseudomorphs. Limy beds are frequently intercalated with the shales. The main mineral is palygorskite, the essential mineral of industrial attapulgite clay. Clay/shale from the Umm Bab-Jalheea area could form the basis for an export industry.	7
Kharj (Area, south)	Clay	Large	Significant clay deposits extending south from Wadi Huwaila to the Saudi Arabia border. The clay is soft and of greenish color and in places up to 3 m thick. In the Nagsh area it is up to 4 m thick consisting of a lower bed of greenish clay 3 m thick and 1 m thinner reddish clay. The greenish clays are currently being quarried for cement manufacturing at the Umm Bab cement plant. The reddish clay could be used for brick manufacturing. The clays belong to the Dam formation.	7

TABLE 9-18: NON-METALLIC MINERAL RESOURCES OF QATAR: BRINES

Location	Ore Type	Deposit Size	Comments	Sources
Zekrit Bay	High salinity sea water	Not available	Zekrit Bay is located in the north west of Qatar. Exhibits high evaporation rates, very low rainfall, highly salty sea water, available natural gas and dolomite. The area could yield up to 500,000 tons of solar salt, 80,000 tons magnesia, 10,000 tons magnesium metal and 1,000 tons bromine per year. These basic chemicals can form the basis for the production of second and subsequent generation chemicals from a local future chemical complex.	7

TABLE 9-19: NON-METALLIC MINERAL RESOURCES OF QATAR: SAND

Location	Ore Type	Deposit Size	Comments	Sources
Doha Wakrah Khor	Calcareous sand	Large	The sand is confined to coastal areas except the southeast. They have been exploited on a limited scale for building construction. The salt and sulfate contents of the sand make it in general unsuitable for building use.	7
Dukhan (South)	Silica sand	Large	Extensive dune sands, generally fine grained, containing around 55% SiO_2. Coarser sand with SiO_2 content of up to 94% has also been located, produced by wind enrichment of dune sands trapped in small hills. The richer sands are not suitable for glass making as the minimum requirement for glass making is 98% SiO_2 and a finer material. Could be used for sand-lime brick manufacturing provided it is extracted from the sabkhahs which act as sources of chemical contamination.	7
Karanah	Alluvial sand	Very large	Very large deposits of alluvial origin adequate to cover the country's needs for many years belonging to the Hofuf formation. A sand quarrying and washing operation is currently in operation.	
Khraij Tass Al-Karanah	Alluvial sand	Very large	Large areas of sand similar to that at Karanah. Beds up to 12 m thick have been identified that could be considered as additional reserves provided gypsum contamination could be avoided.	7

TABLE 9-20: TOTAL NON-METALLIC MINERAL RESOURCES OF THE GCC REGION

Resource of Interest	Ore Type	Deposit Size	Comments
Phosphate	Calcareous phosphate	Over 912 million tons	The deposits are concentrated in Saudi Arabia and average from 18% to 23% P_2O_5. Beneficiation of the ore is not easy, but it could potentially form the basis for the production of phosphates, phosphoric acid and fertilizers.
Gypsum	Gypsum, some anhydride	Very large deposits	Gypsum occurs in Saudi Arabia and the other GCC member states, although the bulk of the known deposits are in Saudi Arabia. The deposits can be used to support local cement and construction materials industry. Expansion of present production levels possible.
Limestone	Limestone	Very large deposits	It is available in abundant supply with varying degrees of purity in the region. It is usually present in the form of limestone suitable for lime production although there are substantial reserves of good quality marble good for use as ornamental stone. Local marble could substitute for marble imported by the construction industry. Lime locally produced is also useful in supporting the cement and building materials industries. Expansion of present production feasible.
Clay	Clays of various types	Large deposits	Clay available in the region is suitable for supporting cement manufacturing and is currently used for this purpose. There is also potential for expanding the brick manufacturing and fired clay products industries in the region. Expansion of present production feasible.

(Continued...)

Resource of Interest	Ore Type	Deposit Size	Comments
Sand	Silica sand	Very large reserves	High quality quartz sand has been located in Saudi Arabia suitable for glass manufacturing. Extensive deposits of lesser quality sand suitable for construction are available. throughout the area. The development of some lesser quality deposits could be restricted because of limitations in the supply of wash water. Expansion of present production possible.
Ornamental stone	Granite, marble	Large reserves	The region is encouraging the use of locally produced and processed ornamental stone. Granite has been located primarily in Saudi Arabia, while marble is available in the UAE too. Ornamental stone produced in the region could substitute for materials now imported by the construction industry. Expansion of current production possible.
Sulfur	Sulfur	Very large reserves	Native sulfur has been located in Saudi Arabia, while sulfide ores could also be considered as a sulfur resource. The greatest potential source of sulfur, however, is natural gas which could contain up to 6% hydrogen sulfide. Natural gas is available throughout the region in vast quantities.
Sodium salts	Rock salt, brines	Very large reserves	Over 1 billion tons of rock salt have been identified in Saudi Arabia while solar evaporation of sea water could produce vast quantities of salt. The use of highly saline sea water from specific locations in the region could increase the productivity of solar evaporation salt plants. Inorganic salt from sea water could be used as feedstock to further "downstream" inorganic chemical industries

(Continued...)

TABLE 9-20: (Continued...)

Resource of Interest	Ore Type	Deposit Size	Comments
			among which production of magnesium and sodium hydroxide (caustic soda) should be mentioned. Caustic soda is required for production of alumina via the Bayer process. Expansion of present production possible.
Gravel	Gravel	Large reserves	Used by the construction industry, it is most readily available in Saudi Arabia. Expansion of present quarrying activities possible.
Magnesite	Magnesite	Over 40 million tons	Known deposits are located in Saudi Arabia containing up to 96% magnesite. The high quality magnesite is only a fraction of identified reserves.

TABLE 9-21: CEMENT PLANTS IN THE GCC REGION

Bahrain	Operating. 400,000 tn/a. Planned expansion to 1,000,000 tn/a.
Kuwait	Operating. 1,425,000 tn/a. Planned expansion to 2,000,000 tn/a.
Oman	New plant. Planned. 600,000 tn/a. Built. 350,000 tn/a.
Qatar	Operating. 330,000 tn/a. Planned to increase capacity by 1,000,000 tn/a.
Saudi Arabia	Operating capacity over 1.8 millions tn/a. Planned to increase to 13,286,000 tn/a.
UAE	Operating capacity 3,100,000 tn/a. Under construction 2,670,000 tn/a.

NOTE: tn/a stands for tons per annum.

CHAPTER 10

WASTE AS A SOURCE OF RECOVERABLE RESOURCES

10.1 INTRODUCTION

Several broad categories of waste might be identified. One example of such categorization is as follows:

(a) Municipal waste: This type of waste is generated, in part, by the normal functioning of households. In addition to material discarded regularly by households it may include bulky items discarded from time to time, such as old furniture or equipment. It also includes material discarded by stores, restaurants, and office buildings.

(b) Industrial waste: Some types of industrial waste are hazardous. The non-hazardous solid components are considered to be generally similar to corresponding forms of domestic and commercial waste. Chemical waste is regarded as a special type within the overall industrial category, and one which requires special treatment.

(c) Construction waste: This is generated in the course of construction activities and takes the form of surplus or damaged construction materials and discarded packaging materials. The category may also include demolition waste and unwanted material resulting from excavation.

(d) Hospital waste: The waste emanating from hospitals, nursing establishments, and the like is similar in some degree to domestic waste. However, it may also contain hazardous components, including pathogenic waste. (Waste from slaughter houses and discarded animal carcases, which are included in industrial waste, are also potentially pathogenic forms of waste.)

(e) Agricultural waste: This includes crop waste (straw, roots), manure, and other bi-products of agricultural processes.

(f) Other forms of waste: These may include such things as waste oil, sludge, abandoned motor vehicles, etc.

The various wastes generated must be treated and disposed of in an economical and hygienically safe and proper manner. However, it should be kept in mind that it is sometimes possible to recover useful materials by means of sorting and processing. Such recovered materials sometimes have high value and could be marketed within the GCC region.

Activities designed to make use of waste as a "resource" for recovery of various materials and products can be looked on as industrial activities: they receive raw material, process it, and sell the resulting products.

The potential amount of material that could be recovered within the GCC member countries is very difficult to estimate because neither the total volume of waste nor its composition is known with any accuracy. However, some rough guesses could be made, based on the limited information that is available. The figures and conclusions arrived at are to be considered as highly tentative, of course.

Many factors bear on the practical utilization of waste and the materials recovered from it, including the method of collection, the location of the waste, the technology of recovery processes, and so on. Any cost-benefit assessment of waste recovery possibilities must take all such factors into consideration. In what follows, some examples of the potentially recoverable materials are presented.

10-2. Domestic, Commercial, and Industrial Solid Wastes

The trend in many countries is towards more and more recycling of solid materials. The components most likely to be considered worth separating and recycling in the GCC countries are paper, metals, plastics, and glass.

At solid wastes treatment plants, metals can be separated from the processed waste, since inexpensive and practical technology exist for this purpose. Technology for the separation of paper and plastics from the refuse is also available, although at higher cost.

Data and assumptions contained in a report relating to Kuwaiti cleansing utilities have been used, in conjunction with other data, to estimate the potential amounts of recoverable components in 1981 in the GCC countries. The estimates are shown in Table 10-1.

TABLE 10-1: POTENTIAL RECOVERY OF MATERIALS FROM DOMESTIC, COMMERCIAL, AND INDUSTRIAL SOLID WASTE, BASED ON 1981 CONDITIONS (THOUSANDS OF TONS)

Country	Total Waste	Paper Cartons	Metals	Plastics	Glass
Bahrain	220	73	17	13	10
Kuwait	1044	351	76	63	49
Oman	506	168	37	30	23
Qatar	167	57	12	10	8
Saudi Arabia	4758	1579	363	285	221
UAE	468	155	36	28	22
Total	7163	2383	541	428	333

The estimates in Table 10-1 should be regarded as upper bounds because it would certainly not be possible to recover all the material.

But even a small proportion of the amounts shown, say 10 percent, could represent valuable inputs to some industries in the region. The absence within the region of natural raw material for the pulp and paper industry, for example, implies that paper and carton materials recovered from waste could play an important role in improving the operating efficiency of existing paper factories and provide a basis for the development of this industry in the future. It is obvious that not all the paper and cartons recovered from waste would be suitable for recycling. However, if an efficient procedure of collection were followed, as in many developed countries, then not only could the quantity of reclaimed waste paper be increased, but also its quality and suitability for recycling.

Cooperation in the collection and recycling of paper materials would seem to be well worth considering. Some quantities of waste paper are already exported from GCC member countries to neighbouring countries for the purpose of recycling by paper factories.

10-3. SCRAPPED VEHICLES

The number of vehicles in use in the GCC countries is estimated at about 2.62 million for 1980, as detailed in Appendix Table 10-E. The number scrapped each year is not known. However, in some countries statistics are available for registered and "de-registered" vehicles.

Only Bahrain records vehicles that are scrapped. The numbers scrapped represented about 5 and 8 percent of the vehicles in use in the years 1980 and 1981, respectively. In earlier years, however, the proportion did not exceed 2 percent. A study relating to Kuwait estimates scrapping in the order 10-15 percent yearly. (This is considered to be on the high side.)

If it is assumed that the scrapping of vehicles would be in the order of 7 percent of the total amount of vehicles in use, then scrapped vehicles in 1980 in the GCC region as a whole would have amounted to about 185,000. (This number represents a fraction of the number of vehicles imported in 1980, it may be noted.) These scrapped vehicles could be used efficiently as input to a plant producing steel iron scrap. However, the costs of transportation of bulky or pressed scrapped vehicles should be taken into account.

In order to estimate the amount of scrapped iron and steel which could be recovered, the following assumptions are made:

(a) The vehicles scrapped consist of about 40 percent American makes and 60 percent Japanese and other makes. The weight of a scrapped vehicle is 1000 kilograms for an American vehicle and 600 kilograms for other makes.

(b) The amount of iron and steel to be recovered represents 75 percent of the weight of a scrapped vehicle.

Based on these assumptions, the amount of iron and steel to be recovered would have been about 105,000 tons in 1980. To this figure should be added an unknown quantity from other metal scrap sources such as tanks, appliances etc. This additional quantity is estimated to be about 10 percent of the above figure, which would make a total of about 115,000 tons in 1980. This total might double by 1995.

10-4. SCRAPPED BATTERIES

There are also large numbers of automotive batteries scrapped each year. Assuming the average service length of a battery in the GCC countries to be about two years, the total number of scrapped batteries would have been about 1,310,000 in 1980. Assuming that about 10 - 12 kilograms of refined lead could be recovered from each battery, then about 15,000 tons of lead could have been recovered in 1980, and the figure might be twice as great by 1995.

The refined lead could be used to substitute for imported lead which is being used in battery factories in the region.

10-5. WASTE OIL

Used oil comes mainly from repair shops, garages, petrol stations, and industrial sites. With about 2.62 million vehicles on the road, and assuming an average of four 5-litre oil changes per year, the annual amount of used oil would be about 53,000 tons. Used oil from other sources is estimated to amount to about half of this quantity, which makes a total of about 75,000 tons in the circumstances of 1980, and a possible 150,000 tons by 1995.

At present, much oil is discharged through the sewerage system, and this creates considerable difficulties for the sewage treatment plants.

Theoretically, waste oil could be used to produce all the products which resulted in the waste oil in the first place, such as lubricating oil, technical oil, and fuel. However, the waste oil is normally too inferior to be considered as crude oil for use in the refineries. On the other hand, special methods have been developed to treat the waste oil so that it can be made suitable for use as fuel. There are also possibilities for the use of specially treated oil as raw material for industrial production but these may entail considerable investment.

10-6. CHEMICAL WASTES

The processing of chemical wastes, which are normally generated by industrial operations, is not as simple as for municipal wastes, because of the heterogeneity and the nature of the wastes. Also, processing would probably require a high cost per unit of processed waste in each individual member country. A first step towards the possible utilization of chemical wastes for resource recovery would be to conduct a detailed investigation of industries, both existing and planned, in order to determine the volumes and characteristics of their waste products.

10-7. OTHER WASTES

Manure and agricultural waste from farms is considered to present no significant problem, either now or for the foreseeable future. The wastes should be taken care of by the farmers themselves at the farms, and should be used as fertilizer and for soil improvement. Sewage sludge is handled at present by the responsible authorities and could be used for agricultural purposes. The many other forms of waste must be examined on an individual basis.

10-8. CONCLUDING REMARKS

These brief comments serve simply to introduce the topic of the possibility of recovering resources by making use of waste materials.

There are some sectors where waste recovery appears a promising possibility -- for example, in the cases of scrap metal and paper recycling. However, the subject is complex, and a close examination is warranted, in view of the expanding industrial activity in the region.

APPENDIX TABLES FOR CHAPTER 10

TABLE 10-A

ESTIMATED AND PROJECTED AVERAGE PER CAPITA AMOUNTS OF DOMESTIC AND COMMERCIAL WASTE, KUWAIT, 1980-1995

(KILOGRAMS)

1980	1985	1990	1995
625	645	665	685

ESTIMATED AND PROJECTED AVERAGE PER CAPITA AMOUNTS OF INDUSTRIAL SOLID WASTE, INCLUDING CONSTRUCTION AND BULKY COMMERCIAL WASTE, KUWAIT, 1980-1995

(KILOGRAMS)

1980	1985	1990	1995
100	110	120	130

SOURCE: *Interim Report*, Kuwait Cleansing Utilities, February 1979.

NOTE: Additional information is provided by an estimate of 450 kilograms for the amount of domestic waste per capita in Saudi Arabia in 1970.

TABLE 10-B

ASSUMED COMPOSITION OF FUTURE DOMESTIC WASTE BASED ON DATA FOR KUWAIT

	% by weight
Paper and cartons	35
Food waste	35
Plastics	6
Metals	6
Glass, porcelain	5
Textiles, wood, leather	8
Miscellaneous	5
Total	100

ASSUMED COMPOSITION OF FUTURE INDUSTRIAL WASTE, INCLUDING CONSTRUCTION AND BULKY COMMERCIAL WASTE, BASED ON DATA FOR KUWAIT

	% by weight
Paper	25
Plastics	6
Metals	15
Glass	3
Rubber	3
Wood	30
Textiles	8
Miscellaneous	10
Total	100

TABLE 10-C

ESTIMATED POPULATION, BY COUNTRY, 1981

	Population ('000)
Bahrain	400
Kuwait	1,440
Oman	920
Qatar	230
Saudi Arabia	8,650
UAE	850
Total	12,490

SOURCE: See Table 2-1 of Chapter 2.

TABLE 10-D

ESTIMATED AND PROJECTED REAL GNP PER CAPITA, BY COUNTRY, 1980-1985 (US DOLLARS AT 1975 PRICES)

	1980	1985	1990	1995
Bahrain	3,300	4,200	5,400	6,900
Kuwait	11,500	12,100	14,000	16,300
Oman	2,070	2,800	3,400	3,800
Qatar	8,320	11,000	13,600	17,300
Saudi Arabia	3,010	4,400	6,800	10,500
UAE	10,480	15,600	19,800	24,900

SOURCE: Projections made jointly by ECWA/UNIDO Industry Division, 1980.

NOTE: Although there is no strict relationship between per capita GNP and per capita domestic waste, GNP per capita can be taken as a rough indicator of such waste, with due consideration to differences in demographic structures among the countries.

To be within safe limits, the figure of waste per capita for Saudi Arabia is used also for Bahrain, Oman, and the UAE. The figure for Kuwait is used for Qatar.

TABLE 10-E

VEHICLES IN USE, BY COUNTRY, 1977-1980

	1977	1978	1979	1980
Bahrain (1)	48,668	54,610	60,717	65,383
Kuwait (2)	379,101	439,553	496,584	542,950
Oman (3)	54,085	66,498	80,500	98,169
Qatar (4)	64,403	74,302	84,098	99,058
Saudi Arabia (5)	-	-	-	1,500,000
UAE (6)	105,716	135,197	55,885	313,200
Total				2,618,760

SOURCE: (1) Statistical Abstract, 1981, State of Bahrain.

(2) Annual Statistical Abstract, 1981, State of Kuwait.

(3) Statistical Abstract of the Region of the Economic Commission for Western Asia, fourth issue, 1981, except for the year 1980, which is estimated.

(4) Annual Statistical Abstract, 1981, State of Qatar.

(5) The Statistical Year Book of the Kingdom for 1980 refers to the numbers of vehicles registered in some provinces of Saudi Arabia for the years 1978, 1979, and 1980. The figures are 319,936, 290,207, and 344,885, respectively. But from import statistics, the number of vehicles in use in 1980 is estimated at about 1.5 million.

(6) Statistical Abstract of the Region of the Economic Commission for Western Asia, fourth issue, 1981, for the years 1977-79. The totals include only Abu Dhabi and Al-Ain. For the year 1980, the estimate is based on the number of vehicles per 100 persons in Kuwait.

PART III

OPTIONS FOR CO-ORDINATED INDUSTRIALIZATION

CHAPTER 11

MATERIALS, PRODUCTS, AND PROCESSES: A TAXONOMY

11-1. INTRODUCTION

Our chief purpose in Part II of this study has been that of stock-taking -- of documenting the known natural resources of the GCC region. We have made every effort to provide as complete and comprehensive a picture as possible of the resource base on which plans for industrial development must build. Our purpose now is to provide a "check list" of some potentially promising avenues for industrial development, keeping in mind the resource base of the region. In the next chapter we shall draw on this "check list" to suggest and discuss a development strategy for the region.

Our approach has involved working with an exhaustive list of commodities and classifying each according to its characteristics, the nature of its production process, and its potential for local production. Such a taxonomy is the focus of this chapter. The procedures underlying it are discussed in the next section. The third and final section examines the resulting "check list" in more detail.

11-2. CLASSIFICATION OF COMMODITIES: THE CREATION OF THE CHECK LIST

We wished to identify classes of commodities whose production might be encouraged in the GCC region. Our approach involved bringing together individuals familiar with the area and with expertise in various branches of economics and engineering (agricultural economics, resource economics, production economics; chemical engineering, mechanical engineering, industrial engineering, metallurgical engineering, and petroleum engineering) to examine an exhaustive list of commodities, and make a preliminary and tentative judgement for each one as to whether production (or increased production) might suitably be encouraged, and whether such production would be mainly for markets in the GCC region or for export, given the resource base and the nature of the commodity in question.

In Chapter 3 we made extensive use of the United Nations Standard International Trade Classification (SITC) system, and that is an appropriate one to use again here. What has been done is to go through the classification at the three-digit level of detail, and at the four- or five-digit level where appropriate, and classify each commodity in terms of (1) its characteristics; (2) the complexity of further processing to which it would be subject; (3) the potential factor intensity of further processing; (4) the value of imports; and (5) the actual or potential market for production within the GCC region. The results are summarized in Table 11-1.

The characteristics of a commodity are independent of where the commodity is produced. Each commodity has been classified as a raw material, a semi-finished good, or a finished good. It is recognized that such classification is, in some degree, arbitrary. Some commodities (clay or butter, for example) may be regarded as finished goods for some purposes, but enter into further processing for other, and hence may be considered semi-finished. For other commodities (fruit or vegetables, for example), there may be little distinction between the raw material and the finished good, since only very simple processing intervenes. Nonetheless, the classification is provided as an indication of the typical nature of each commodity.

Processes range from very simple ones, requiring only unskilled labour and unsophisticated technology, to highly complex ones, requiring specialized human skills and specialized industrial processing equipment. We have attempted to classify the further processing requirements for each commodity, in terms of whether they are nearer to the "simple" or the "complex" end of the spectrum. Again, there is an element of arbitrariness in such classification, but the processes can nonetheless be grouped in a generally informative manner. We have also indicated whether further processing is capital-and/or energy-intensive. The interest in these categories stems from the fact that the area can acquire physical capital in exchange for its natural resources, and that it has an abundance of energy resources. At the same time, human resources are in relatively short supply, as is fresh water. Thus interest in large-scale industrial development activities would most naturally be concentrated in activities which are (at least potentially) capital-and/or energy-intensive, which can draw on the natural resource base of the area, and which can economise on the scarce supplies of human resources. (It should be emphasized that in speaking of potential intensity, we have in mind relative factor proportions -- capital or energy per unit of labour -- and not output-factor proportions -- capital or energy per unit of output).

The value of imports provides an indication of the current market for each commodity in the GCC region. (The indication is better, of course, the less the local production.) It can serve as a guide when considering the possibility of encouraging production as a substitute for the importation of certain commodities. (No comprehensive data are available regarding production in the region at the commodity level of detail. However, in view of the relatively low production levels of most commodities except oil, gas, and a few others, import data do, in fact, provide a good indication of local consumption.) As in Chapter 3, import figures for 1979 are used, since that is the most recent year for which comprehensive data are available at the commodity level of detail. The figures reported in Table 11-1 are in millions of US dollars.

Production, either current or potential, may be solely or primarily for the market within the GCC region, or it may be on a scale primarily for export (while satisfying local demands as well). An indication of the likely nature of the market is provided in the second-to-last column of the table.

The last column of the table allows for brief comments, and comments have been made for most, though not all, commodities. Frequently the comment is "not applicable". This should be taken to mean that, on the basis of a preliminary assessment, the commodity is not one whose production should be encouraged at this time. The possible reasons are diverse. In some cases the production processes may be highly labour-intensive, or require large volumes of fresh water, either of which requirements would make them unsuitable for large-scale production in the region. For others, the raw materials may not be available in the region (or at least not known to be available), so that production would depend on raw material imports. Such cases should not, of course, be ruled out; the current production of aluminum, for example, is based on imported raw materials. Indeed, joint ventures leading to the production of goods which are intensive in their use of capital and energy are worthy of consideration, whatever the source of raw materials. However, it has not been possible to explore such possibilities systematically in this study. Instead, we have tried, in the main, to identify commodities, or classes of commodities, whose production is based in significant part on the natural resources available in the area and which might, on closer investigation, prove good candidates for encouragement.

As seen in Chapter 3, the SITC scheme divides all commodities into ten major "sections". For present purposes we have found it sufficient to consider only the first seven (sections 0 through 6), since the commodities in the last three sections are mostly specific examples of "further processing" covered in discussing the previous sections of the classification system. (Further examples of such products, specifically capital goods, are discussed in Chapter 12, below.)

11-3. DETAILED COMMENTS ON THE CHECK LIST

We now turn to a closer look at the commodities of the check list, indicating those which seem to be relatively promising for the region and those which do not. It is convenient to proceed through the table section by section.

Food and Live Animals

As discussed in Chapters 5 and 6, there are severe constraints on the amount of food that can be produced economically in the GCC region, because of the very limited availability of fresh water, the extreme heat in the summer months, and the quality of the soil. However, there is little doubt that much more local production and processing could take place economically. Encouragement of production in appropriate cases may be especially appealing, in view of the generally low levels of food self-sufficiency and the concerns about food security.

Consider the case of live animals and of meat, for example. In 1979, some $376 million were spent to import live animals and a further $520 million to import meat. Some of the imported live animals, along with others raised domestically, were presumably among the very large number of animals sacrificed during holy Haj. In 1979, for instance, an estimated 2.08 million people made the pilgrimmage to Mecca. For each person one live animal would be sacrificed, and often more than one.[1] It is evident that the time of Haj alone represents a potentially significant source of meat and hides, if some means could be found to deal with the huge number of animals sacrificed in a very short period of time (presumably by removing the hides and freezing the meat). If some means could be found to make use of even a fraction of the animals sacrificed, less meat would have to be imported, and perhaps hides could be used locally or else exported.

There appear to be good prospects also in the case of poultry production. Poultry provides a relatively high yield per unit of feed, compared to sheep or cattle, and also requires less space and little specialized equipment. Furthermore, much of the poultry feed could be provided within the region, by making use of the fish by-catch and local grain. Thus there is a reasonable prospect that the region could become self-sufficient in poultry and also in eggs.

The much greater demands on feed grains, and the unsuitable climatic conditions, make the production of cattle a far less attractive option. However, as noted in Chapter 5, the stock of cattle in the region has increased substantially in recent years while the stocks of sheep and goats have grown much less rapidly, and the camel population has not grown at all. Perhaps greater attention should be paid to sheep, goats, and camels which are, by nature, better adapted to the region. It may be, for example, that further agricultural research could enhance considerably the milk-producing and flesh-producing potential of these animals, and that they could supply a larger fraction of the demands within the region without relying on substantial increases in imports of feed grains.[2]

Fish and fish products represent another area which could be expanded considerably, as noted in Chapter 6. The waters surrounding the

Gulf states have not been harvested as much as they might be. An increased catch might reduce the volume of fish imports, and would also allow exports to grow. In addition the by-catch could be better utilized, both as a protein supplement for animals and fowl, and as a fertilizer. Indeed, as is argued in the next chapter, the fish industry could be integrated into a whole interrelated complex of activities including fishing itself, boat-building and repair activities, fertilizer and feed production, and certain aspects of food processing, among others.

With respect to the major field crops, such as wheat, rice, barley, and maize, the costs of production in the region are relatively high, and it would seem best not to encourage substantial increases. The critical element is, of course, the shortage of water. It was suggested in Chapter 5 that the political imperative of a secure food supply could be purchased much more cheaply by storing grain on a large scale than by production within the region. The preparation of flour, meal, and other cereal-based products might then be encouraged on a limited basis, as an integral part of a comprehensive policy of food security, to supply the market of the region. However, such production is relatively labour-intensive, and not suitable for expansion beyond the level necessary to meet regional needs.

Similar comments apply to sugar, coffee, chocolate, and many other food products: local production is not likely to be prove cost-effective, and it would be far cheaper to ensure domestic supplies by appropriate inventory and storage policies than by domestic production.

The situation is quite different with respect to certain fruits, vegetables, and nuts. Dates and citrus fruits are already being exported, and increased production to meet both regional and export markets seems desirable. There are seasonal surpluses in other fruit and vegetable crops as well, and it should be possible for them to be marketed more extensively in the region and elsewhere.

Beverages and Tobacco

There is already a considerable volume of beverage production within the region, much of it based on adding desalinated water to imported syrups. Such current production can be expanded as necessary, to meet the relatively large demands of the region, and could draw to a greater extent on domestic fruit and vegetable production.

The import of tobacco manufactures exceeded $400 million in 1979. It may be that local processing of imported tobacco leaves could reduce such imports. However, such processing activities do not appear well suited to the region because of the labour-intensive nature of production and the strength of loyalties to particular brands of tobacco products.

Crude Materials, Inedible Except Fuels

Included in this section is a wide range of materials -- from animal hides to charcoal to uranium ore. Only brief elaboration on the comments in Table 11-1 is required. For convenience, the comments are organized around those commodities associated with the development of the food processing industries, the chemical and petrochemical industries, and the mining industry.

Associated with the development of the food processing industries, there will be increasing scope for the utilization of animal by-products in the form of hides and skins (code 211), wool and animal hair (code 262), and fertilizers (code 271). Industries based on the utilization of such commodities would probably prove cost-effective, in certain cases. The raw materials are available in the region, and the capital and labour requirements are minimal.

The production of synthetic rubber (code 231.2) and synthetic fibres (code 266) would be possible in association with the development of the chemical and petrochemical industries. Whether these particular products should be emphasized is a matter which requires much more detailed study than is possible here. It is clear, however, that petrochemical products, particularly basic and intermediate products, will soon flow from the Yanbu and Al-Jubail complexes in Saudi Arabia and the other complexes in Kuwait, Qatar, Bahrain, and the UAE. The output will greatly exceed the demand within the region, and may even have to compete in a "soft" world market. Thus the marketing of the output is a matter for urgent concern. Part of the output might be used within the GCC region itself, or in neighbouring Arab countries, if "downstream" activities develop to produce such final goods as synthetic fibres and plastics. However, broader markets are necessary.

The further development of the mining industry would bring with it promise for the production or increased production of a wide range of products, some of which might be used in place of imports and others of which would have, potentially, world markets. Again, however, it must be emphasized that these comments refer only to a check list of possibilities which appear to be worthy of careful investigation.

Crude fertilizers (code 271) could be produced, drawing not only on the by-catch of the fisheries and on animal by-products, as previously noted, but also on local phosphorite deposits. It may even prove worthwhile to displace imports of not only crude fertilizers but also manufactured fertilizers in this way, and to export the manufactured fertilizers of the petrochemical industry. A careful study would be required, but the potential is there.

There are substantial deposits of stone, sand, and gravel in the region. It is quite possible that a close examination of the matter would determine that domestic production could substitute for most or all of the imports of such materials (which amounted to $75 million in 1979), and could do so in a cost-effective way. Such production would be closely tied to the construction industry in the region.

Sulfur is in abundant supply, as a by-product of the oil and gas industries, and the region may wish to take advantage of this resource as industrialization proceeds. Sulfur is very widely used in industrial processes, in the form of sulfuric acid, among others.

The production of clay and other refractory materials could be based on local clay deposits, and be undertaken in association with the growth of the cement industry.

High salinity sea water is in abundant local supply, and there is the potential for a "downstream" inorganic chemicals industrial complex. Such production is capital- and-energy intensive, and as such is suited to the area. The products might be used, in part, as inputs into other local production. For example, if the region's aluminum industry were pushed back one stage to include the refining of alumina from imported bauxite (rather than importing the alumina itself), large volumes of caustic soda would be required.

There is the potential for producing glass and quartz glass, by utilizing local deposits of high quality silica sand. The processes are intensive in the use of capital and energy.

There is also the potential for the production or expanded production of iron, copper, aluminum, lead, zinc, gold, silver, and other metals. There are deposits of these metals in the region, which suggests the possibility of undertaking or expanding mining operations, in cases where the deposits are of sufficient size and quality. Also possible would be the expansion of smelting and refining activities, based on the use of either local or imported ores, as appropriate. Smelting and refining involve major capital investments, and use large amounts of energy. Large commitments have already been made within the region in the production of iron, copper, and aluminum, as noted in Chapter 8. Large-scale investments to make possible the production of other metals might also be justified after careful study. However, it is important that production capacity elsewhere in the world be kept in mind, since the regional market alone may not be sufficient for a viable industry, in all cases. For example, iron and steel should probably be directed to the regional market alone, whereas the minimum efficient scale of plant for producing aluminum requires that such production be geared to export markets. Further consideration of the development of industries based on metallic mineral resources is provided in Chapter 12.

Mineral Fuels, Lubricants, and Related Materials

This group includes petroleum and natural gas, both of which are, of course, in abundant supply in the area. The principle of comparative advantage suggests that the region should specialize in industries which draw on these resources, as has been noted repeatedly.

Crude petroleum now accounts for almost all of the exports from the GCC region, and also for very large fractions of the gross national products of the individual countries. As of the beginning of the 1980's, the region had the capacity to refine only about 10 percent of its production. Since crude petroleum must be refined before it can be used as a fuel, as a lubricant, or as a feedstock to the petrochemical industry, it would seem obvious that further refinery capacity should be an investment priority for the region. However, it must be recognized that transportation costs are considerably higher for the refined products than for crude oil, and also that the costs of installing and operating refineries tend to be high in the GCC region. As was argued in Chapter 7, the first difficulty may be circumvented by developing some of the relevant backward linkages, including the further expansion of regionally owned shipping facilities. However, such an undertaking would make sense only if the differential rates now charged for transporting refined petroleum exceed true cost, and the own-provision of such services is the only alternative. The costs of installing and operating refineries -- the second difficulty -- may decline as local experience is gained, the general infrastructure improves, and associated complementary industries develop. The refining industry, at all stages, requires small numbers of highly trained, specialized personnel. As the supply of such people within the region grows, costs should fall. At the same time, it must be recognized that process changes which result from the introduction of new technology may have substantial impacts on cost and also that such technology, because of patents, may be proprietary in nature, and available through joint ventures with large international corporations, only if negotiated. In addition, the increasing automation in the chemical industry, based on the extensive use of computers and process control equipment, implies a continuing dependence on those who develop, produce, and maintain high technology equipment of this sort.

Below we comment further on the uses of refined crude in the chemical industry; here we consider it as an input in fuels and lubricants. A number of fuels and lubricants based on crude or refined petroleum are listed as codes 331.0(2) through 332.6 in Table 11-1. For these products, excess productive capacity already exists within the region, and exports would be possible. However, the products themselves do not store or travel well, because of their nature (some are highly flammable, some corrosive, and others both), so for that reason the best prospects for export markets would be to nearby countries.

Electricity in the GCC region is generated mostly through the use of thermal power stations. Naturally the region has an advantage in the production of commodities which have high electric energy requirements, such as the electrolytic refining of metals or the production of aluminum. As an aside, it may be noted that various countries in the region are not on uniform power grids, and that the efficient utilization of this resource would benefit from grid unification.

Animal and Vegetable Oils and Fats

The only commodities in this group which would appear to be candidates for the production in the region are animal oils and fats (code 411). The processes involved are simple. The products would be for the regional market, and would form a part of the developing food industry. They would make use of animal and fish by-products.

Chemicals

The region has a major comparative advantage in the production of commodities in the chemicals section. The products, in most cases, are based on petroleum or natural gas, both of which are in abundant supply in the area, and typically require large-scale capital investment and the use of large amounts of energy for production. These are, therefore, commodities which are promising candidates for production within the region.

This advantage has not gone unnoticed, of course, and much large-scale investment has already taken place. Many plants have already begun production and others are under construction, as noted in Chapter 7. Furthermore, the petrochemical plants draw exclusively on associated gas rather than on natural gas as a feedstock and as a fuel.[3] This appears to be a very wise practice, since the associated gas would otherwise have to be flared, while natural gas can simply be left in the ground for the moment, and petroleum, which could also be the basis of a feedstock, can instead be exported in its crude form. Of course, by limiting the feedstock to associated gas, the potential ouput of the chemical industries is made to depend on the volume of crude petroleum which is pumped. If the demand for associated gas should grow substantially while that for crude petroleum remains low, the output of the petrochemical industry would be constrained.

In spite of the natural advantages of the region, however, there are risks and possible pitfalls associated with industrial development in the petrochemical industry, and these must be recognized and taken into account. Production must ultimately be geared to the market, and the market for the final products of the petroleum industry is worldwide, highly diversified, and typically controlled by large international corporations. The problem for the countries in the GCC region is to determine, first, how and where to enter this market, and secondly, to assess how the production facilities might best be allocated among the countries of the region. It would be easy enough to make huge investments in facilities which would ultimately prove unprofitable because the expected markets did not materialize, or because important changes in production technology reduced the costs of production elsewhere. It would also be an easy matter for the GCC region to swamp the market for a particular product as the result of unwarranted duplication of facilities.

Since the nature of the industry is that the output of one phase serves as the feedstock of the next, it would seem sensible for the GCC region to concentrate the development of its large-scale production facilities on those products for which the market is large. That typically would mean products at the basic and intermediate stages of production -- basic products such as the olefins, the aromatics, and methanol, and intermediate products such as ethylene glycol, ethylene oxide, styrene, and urea. For products such as these, which are at the mature stage of the product cycle, technological obsolescence, while always a possibility[4], is generally less likely than in the case of products further up the production chain. Furthermore, there is reasonable assurance both that the world market will continue to be large, and that it will have a high price elasticity of demand, thereby allowing the GCC producers to gain a sizeable share of the market. There is also considerable scope for the countries in the GCC region to avoid undesirable duplication by specializing in the production or various types of basic and intermediate products. Even with considerable expansion of its current capacity, the GCC region would not provide a very large fraction of the world production of such products, and given the low costs of the feedstocks available in the region, a good competitive position is pretty well assured. Furthermore, the marketing of such products would provide important experience, and enhance the ability of producers in the region subsequently to compete in the production of other, more complex commodities.

Specialization at the beginning and intermediate stages appears to be the approach which has, in fact, been adopted. As noted in Chapter 7, the major initial investments have been concentrated very heavily in the production of olefins. Further investment could concentrate more in this area, extend into the production of the aromatics, or go further along the olefin chain. In practice, it seems best to emphasize these areas, while staying at the relatively early stages of the production chain for some years yet. At such stages the market is much more predictable and, in any case, the region would be well positioned to meet the competition.

Manufactured Goods Classified Chiefly by Material

This last section of commodities contains an enormous range, as the section title suggests.

The production of leather (code 611) is a promising possibility, partly in connection with the anticipated growth of the food and agricultural industry, but also in connection with the possible use of animals sacrificed during Haj, as noted before. The required processing is of a simple nature, and hides could possibly be exported for further processing if there is no domestic outlet for them.

It would also be possible to produce some paper products of the sort indicated in code 642, based on recycling of the paper available in the region, as discussed in Chapter 10.

Among the most promising products are some based on locally available deposits of non-metallic and metallic minerals. The enormous volume of construction activity could draw on deposits in the region to produce lime, cement, and other fabricated building materials (code 661) and also glass (code 664), and thereby substitute for some imported goods. In 1979, the imports in these two categories amounted to well over $1 billion. In a similar vein, it would be possible to draw on regional deposits of clay to produce required clay construction materials and refractory construction materials (code 662), and thereby to displace some of the imports (which amounted to almost $300 million in 1979). Care must be taken, however, to avoid unnecessary duplication of production facilities and to avoid expanding the total productive capacity beyond the anticipated regional and export demand.

Another set of products which holds out great promise for production in the region is associated with the iron and steel industry. We have in mind here many of the items indicated by SITC codes 671.3 through 679. As discussed in Chapter 8, very large investments have already been made. An iron processing plant is now operating in Qatar and there are steel rolling plants in Saudi Arabia and the UAE. In addition, an iron ore pelletizing plant is under construction in Bahrain, integrated steel plants are under construction in Oman and the UAE, and an integrated sponge iron and steel plant is to be built in Saudi Arabia. Such plants will apparently rely heavily on imported iron ore supplies, since local deposits are of relatively low quality. These local deposits may prove more valuable in time, if technological advances solve some ore beneficiation problems. It may prove cost-effective to blend local deposits with imported ones of higher grade (whose supply might be better secured by investments abroad). Production of iron and steel products is likely to be mainly for the regional market and might make use of the direct reduction method rather than more traditional approaches. The direct reduction method may be appropriate for the region since it permits efficient production of relatively small volumes of output, is energy intensive, and uses gas instead of coke as a feedstock.

Clearly, the size of the regional market for iron and steel depends largely on the volume of construction activity. The latter, in turn, is determined in large measure by government contracts; a conscious policy of steady and not-too-rapid growth of the construction industry would facilitate and promote the steady development of efficient supporting industries. We note that in 1979 the imports of iron and steel products in the groups from code 671 through 679 of this section exceeded $2.6 billion.

Somewhat similar comments apply to the possible production of copper and aluminum manufactured goods (codes 682 and 684). There is already a substantial related investment in the region. For example, copper is now produced in Oman, based on the smelting of its own copper ores, and the deposits appear to be sufficient to support copper-using industries for some years. Aluminum is now produced in both Bahrain and the UAE, based on imported alumina. Bauxite deposits have been located in Saudi Arabia, but we have little information about them, If they are of suitable grade, and available in sufficient quantity, local bauxite (perhaps in combination with imported bauxite) might be used to produce alumina, and create a more integrated aluminum industry in the region.

The production of copper and aluminum goods could be expanded, but such production would require careful attention to the export market. Again, it is a matter of deciding on the specific product types which are especially suited to production in the region. The general strategy enunciated in connection with the chemical industry seems appropriate. That is, the region might be wise initially to specialize in the production of the more basic products in these industries. Such specialization would allow the industries to develop, would give the indigenous population relevant experience in both the production and the marketing of such products, and would thereby form a base for subsequent expansion into other areas of production. Such a strategy at the early stages of production has the great advantage of providing a critical element of experience while keeping low the risks of making vast investment commitments in what might ultimately prove to be inappropriate directions.

Table 11-1 concludes with a variety of commodities which make use of various metals. Several of these have potential for production in

the region, typically for the local market rather than for export. The metals themselves are now, or soon will be, available from local suppliers, and the choice of what to produce should, of course, be guided by market considerations.

FOOTNOTES TO CHAPTER 11

1. The number of animals per person depends on the type of animal. In the case of lambs, for example, at least one is sacrificed.

2. Science, September 1982, pp. 79-80.

3. Industrial activities such as smelting and electricity generation in the region also make use of associated gas.

4. For example, Dow Chemical has recently announced the development of a new ethylene production process, referred to as partial combustion cracking (PCC), in which ethylene can be produced directly from crude oil, in one step, or by using such other feedstocks as residual oil, gasoil, or naptha. It is claimed that the cost of ethylene produced in this way is considerably lower than when produced via LPG or naptha cracking. (Chemical Engineering Progress, Vol. 79, No. 2, February 1983, pp. 78-81).

TABLE 11-3: CLASSIFICATION OF COMMODITIES BY PRODUCTION AND MARKET CHARACTERISTICS, FROM THE PERSPECTIVE OF THE GCC REGION (Commodities defined as in the United Nations Standard International Trade Classification Scheme, Revision 1)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
Food and Live Animals											
001	Live animals	✓			✓				376.4	✓	- area has best potential in poultry production - Haj provides source of meat and hides which may have commercial potential; however costs must be considered carefully - limited exports of specialized breeding stock possible, based on recent imports
011	Meat, fresh, chilled or frozen		✓		✓				487.0	✓	
012	Meat, dried, salted or smoked, whether or not in airtight containers		✓		✓				1.6	✓	
013	Meat in airtight containers, n.e.s. and meat preparations, whether or not in airtight containers		✓		✓				32.1	✓	
022	Milk and cream		✓		✓				265.7	✓	- possible trade within region, based on expanded production
023	Butter		✓		✓				55.8	✓	
024	Cheese and curd		✓		✓				113.3	✓	
025	Eggs	✓			✓				40.3	✓	- good potential for self-sufficiency
031	Fish, fresh and simply preserved		✓		✓				33.8	✓	- good potential for self-sufficiency
032	Fish, in airtight containers, n.e.s. and fish preparations, whether or not in airtight containers (including crustacea and molluscs)		✓						39.5		- not attractive, because of water and labour requirements
041	Wheat (including spelt) and meslin, unmilled	✓			✓		✓		123.8	✓	- costs of productions very high; not good prospects for expansion
042	Rice	✓			✓		✓		431.1	✓	
043	Barley, unmilled	✓			✓		✓		132.2	✓	
044	Maize (corn), unmilled	✓			✓		✓		108.2	✓	
045	Cereals, unmilled, other than wheat, rice, barley and maize	✓			✓		✓		11.9	✓	

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports[a] (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
046	Meal and flour of wheat or of meslin		✓		✓				171.7	✓	- costs of production high; not good prospects for expansion
047	Meal and flour of cereals, except meal and flour of wheat or of meslin		✓		✓				18.6	✓	
048	Cereal preparations and preparations of flour and starch of fruits and vegetables		✓		✓				161.7	✓	
051	Fruit, fresh, and nuts (not including oil nuts), fresh or dried	✓			✓				345.6	✓	- some exports (mostly dates, citrus); potential for increased production
052	Dried fruit (including artificially dehydrated)		✓		✓				10.9		
053	Fruit, preserved and fruit preparations		✓		✓				259.6	✓	
054	Vegetables, fresh, frozen or simply preserved (including dried leguminous vegetables); roots, tubers and other edible vegetable products, n.e.s., fresh or dried	✓			✓				197.7	✓	- have seasonal surpluses in some crops; limited export potential
055	Vegetables, roots and tubers, preserved or prepared, n.e.s., whether or not in airtight containers	✓			✓				115.0	✓	
061.1	Raw sugar, beet and cane (not including syrups)	✓			✓				10.8	✓	- limited prospects for production
061.2	Refined sugar and other products of refining beet and cane sugar (not including syrups)		✓		✓				89.6	✓	
061.5	Molasses		✓		✓				.5	✓	
061.6	Natural honey		✓		✓				5.7	✓	
061.9	Sugars and syrups, n.e.s. (including artificial honey and caramel)		✓		✓				7.4	✓	
062.	Sugar confectionery and other sugar preparations (except chocolate confectionery)		✓		✓				68.3	✓	

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports[1] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
071	Coffee		✓		✓				72.9			- limited prospects for production
072	Cocoa		✓		✓				1.3	✓		
073	Chocolate and other food preparations containing cocoa or chocolate, n.e.s.		✓						42.7			
074	Tea and maté		✓						118.7			
075	Spices		✓						162.0			
081	Feeding-stuff for animals (not including unmilled cereals)		✓		✓				68.6	✓		- possible only at very high costs
091	Margarine and shortening		✓		✓				23.9	✓		
099	Food preparations, n.e.s.		✓		✓				122.1	✓		
Beverages and Tobacco												
111	Non-alcoholic beverages, n.e.s.		✓		✓				216.3	✓		- current production could be expanded
112	Alcoholic beverages								40.4			- not applicable
121	Tobacco, unmanufactured	✓			✓				5.3	✓		
122	Tobacco manufactures		✓						402.5	✓		- possible production based on imports, but not promising area
Crude Materials, Inedible, Except Fuels												
211	Hides and skins (except fur skins), undressed		✓		✓				.2	✓		- export potential associated with meat processing
212	Fur skins, undressed		✓		✓				.0			- not applicable
221	Oil-seeds, oil nuts and oil kernels	✓			✓				24.4	✓		- not applicable
231.1	Natural rubber and similar natural gums	✓				✓	✓	✓	1.1		✓	- not applicable
231.2	Synthetic rubber and rubber substitutes		✓			✓	✓	✓	.6		✓	- will have raw materials available by 1985
231.3	Reclaimed rubber		✓						.0			- not applicable

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity[1]			Further processing		Potential intensity		Value of Imports[2] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
231.4	Waste and scrap of unhardened rubber								.1			- not applicable
241	Fuel wood and charcoal			✓					4.4			- not applicable
242	Wood in the rough or roughly squared	✓			✓				97.4	✓		- not applicable
243	Wood, shaped or simply worked	✓			✓				264.0	✓		- not applicable
244	Cork, raw and waste	✓			✓				1.3	✓		- not applicable
251	Pulp and waste paper	✓			✓		✓	✓	.3	✓		- local raw materials; potential for small scale paper recycling
261	Silk	✓			✓				.1			- not applicable
262	Wool and other animal hair	✓			✓				.2	✓		- potential associated with live animal processing
263	Cotton	✓			✓				2.6	✓		- not applicable
264	Jute	✓							.1			- not applicable
265	Vegetable fibres, except cotton and jute	✓							.5			- not applicable
266	Synthetic and regenerated (artificial) fibres		✓		✓				.2		✓	- potential associated with petrochemical industry
267	Waste materials from textile fabrics (including rags)								4.9			- not applicable
271	Fertilizers, crude	✓			✓		?	?	4.6	✓		- potential associated with phosphorite deposits and with fisheries by-catch
273	Stone, sand and gravel	✓			✓				75.2	✓		- substantial local deposits could substitute for imports
274	Sulfur and unroasted iron pyrites	✓			✓		✓	✓	.4		✓	- potential for self-sufficiency in sulphur
275	Natural abrasives (including industrial diamonds)	✓							6.4			- not applicable
276.1	Natural asphalt and natural bitumen	✓				✓	✓	✓	2.0		✓	- minimal potential

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of imports[1] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
276.2	Clay and other refractory minerals, n.e.s.	✓			✓			✓	5.8	✓		- potential for expansion based on local deposits, associated with growth of cement industr
276.3	Salt (including salt put up for retail sale, salt liquors and sea water)	✓				✓	✓	✓	7.6		✓	- abundance of raw materials; potential for downstream inorganic chemicals industrial complex
276.4	Asbestos, crude, washed or ground (including asbestos waste)	✓							25.9			- not applicable
276.5	Quartz, mica, felspar, fluorspar, cryolite and chiolite	✓				✓	✓	✓	1.0	✓		- potential for utilizing local deposits for production of glass and quartz glass
276.6	Slag, dross, scalings and similar waste, n.e.s.	✓							.3			- not applicable
276.9	Minerals, crude, n.e.s.	✓							4.5			- not applicable
281	Iron ore and concentrates	✓				✓	✓	✓	18.7	✓		- potential for development of local deposits
282	Iron and steel scrap	✓				✓	✓	✓	24.7	✓		- potential for development
283.1	Ores and concentrates of copper (including copper matte)	✓				✓	✓	✓	.1		✓	- potential for expansion of mining, smelting and refining
283.2	Ores and concentrates of nickel (including nickel matte)	✓				✓	✓	✓	.1		✓	- not promising because of limited local deposits and vast refining capacity elsewhere
283.3	Bauxite and concentrates of aluminium	✓				✓	✓	✓	.9		✓	- potential for expansion based on local and imported resources
283.4	Ores and concentrates of lead	✓				✓	✓	✓	.0		✓	- potential for development, bu local deposits are limited
283.5	Ores and concentrates of zinc	✓				✓	✓	✓	.2	✓		- potential for development
283.6	Ores and concentrates of tin	✓				✓	✓	✓	.0		✓	- not applicable

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports[a] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
283.7	Ores and concentrates of manganese	✓				✓	✓	✓	.1		✓	- not applicable
283.9	Ores and concentrates of non-ferrous base metals, n.e.s.	✓				✓	✓	✓	9.1		✓	- potential, but resources not confirmed
284	Non-ferrous metal scrap	✓							10.9			- not applicable
285	Silver and platinum ores	✓				✓	✓	✓	.1		✓	- potential for development of local deposits, in association with development of zinc and lead
286	Ores and concentrates of uranium and thorium	✓				✓	✓	✓	.0	✓		- possible recovery of uranium from phosphorites
291	Crude animal materials, n.e.s.	✓							1.0			- recall Oil
292	Crude vegetable materials, n.e.s.	✓							40.3			- not applicable
Mineral Fuels, Lubricants and Related Materials												
321	Coal, coke and briquettes	✓							6.6			- prospects identified in Saudi Arabia
331.0(1)	Crude petroleum	✓				✓	✓	✓	.4		✓	- huge reserves; major potential for further development
331.0(2)	Petroleum, partly refined (including topped crudes)		✓			✓	✓	✓	.0		✓	- productive capacity in excess of regional market already exists; best potential for exports is to countries nearby since transportation costs are relatively high for these products
332.1	Motor spirit (gasolene and other light oils for similar uses, including natural gasolene)		✓			✓	✓	✓	159.3		✓	
332.2	Lamp oil and white spirit (kerosene, illuminating oil, jet fuel)		✓			✓	✓	✓	122.9		✓	
332.3	Distillate fuels		✓			✓	✓	✓	304.2		✓	
332.4	Residual fuel oils		✓			✓	✓	✓	91.1		✓	

(Continued...)

TABLE 11-1: (continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports[a] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
332.5(1)	Lubricating preparations containing at least 70% by weight of petroleum products		✓			✓	✓	✓	112.3		✓	- productive capacity in excess of regional market already exists; best potential for exports is to countries nearby since transportation costs are relatively high for these products
332.5(2)	Lubricating preparations containing less than 70% by weight of petroleum products		✓			✓	✓	✓	.2		✓	
332.6	Mineral jelly and waxes (including petrolatum)		✓			✓	✓	✓	.3		✓	
332.9	Pitch, resin, petroleum asphalt, coke of petroleum and other by-products of coal, lignite, petroleum and oil shale (including mixtures with asphalt), n.e.s., not chemicals		✓		✓				53.5	✓		- of potential interest for region
341	Gas, natural and manufactured	✓				✓	✓	✓	18.2		✓	- huge reserves; best potential in liqu-faction of propane and butane
351	Electric energy		✓		✓		✓	✓	...	✓		- great potential for thermal power generation; need for grid unification
Animal and Vegetable Oils and Fats												
411	Animal oils and fats	✓			✓				1.8	✓		- recall 011
421	Fixed vegetable oils, soft	✓			✓				35.6	✓		- not applicable
422	Other fixed vegetable oils	✓			✓				108.5	✓		- not applicable
431	Animal and vegetable oils and fats, processed, and waxes of animal or vegetable origin		✓		✓				10.1	✓		- not applicable
Chemicals												
512.1	Hydrocarbons and their halogenated, sulfonated, nitrated or nitrossated derivatives		✓			✓	✓	✓	13.4		✓	- current development; potential for future

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
512.2(1)	Methyl alcohol (methanol)		✓			✓	✓	✓	.5	✓	- will be produced; need expansion
512.2(2)	Other acyclic alcohols and derivatives		✓			✓	✓	✓	.4	✓	- difficult to enter markets
512.2(3)	Cyclic alcohols and derivatives		✓			✓	✓	✓	.0	✓	- difficult to enter markets
512.2(4)	Ethyl alcohol, undenatured, of at least 80 degrees strength, and denatured spirits		✓			✓	✓	✓	.1	✓	- good market prospects; expand
512.2(5)	Fatty alcohols		✓			✓	✓	✓	.0	✓	- marketing and distribution considerations are of overriding importance
512.2(6)	Glycerol and glycerol lyes		✓			✓	✓	✓	.0	✓	
512.2(7)	Phenols and phenol-alcohols		✓			✓	✓	✓	.0	✓	
512.2(8)	Derivatives of phenols or phenol-alcohols		✓			✓	✓	✓	.0	✓	
512.3	Ethers, epoxides, acetals		✓			✓	✓	✓	1.5	✓	- must consider potential markets; technology restricted to certain suppliers; licences may not be available
512.4	Aldehyde-, ketone- and quinone-function compounds		✓			✓	✓	✓	4.1	✓	- same as 512.3
512.5	Acids and their halogenated, sulfonated, nitrated or nitrosated derivatives		✓			✓	✓	✓	3.3	✓	- same as 512.3
512.6	Inorganic esters, their salts and derivatives		✓			✓	✓		.2	✓	- looks promising
512.7	Nitrogen-function compounds		✓			✓	✓		2.9	✓	- same as 512.3
512.8	Organo-inorganic and heterocyclic compounds		✓			✓	✓		.8	✓	- same as 512.3
512.9	Other organic chemicals		✓			✓			4.4	✓	- same as 512.3
513.1	Oxygen, nitrogen, hydrogen, rare gases		✓			✓	✓		4.2	✓	- some associated with other production

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
513.2	Chemical elements n.e.s.		✓			✓	✓	✓	4.2		✓	- promising, except 513.2(5)
513.3	Inorganic acids and oxygen compounds of non-metals or metalloids		✓			✓	✓		8.2		✓	- promising, excluding (6) and (7)
513.4	Halogen and sulphur compounds of non-metals or of metalloids		✓			✓	✓		.1		✓	- promising, in view of the expanding chemical industry
513.5	Metallic oxides, of kinds principally used in paints		✓			✓			5.4	✓		- promising, but consider economies of scale
513.6(1)	Ammonia, anhydrous or in aqueous solution		✓			✓	✓	✓	.7		✓	- large investment committed; large export potential
513.6(2)	Caustic soda (sodium hydroxide)		✓			✓	✓	✓	3.8		✓	- promising, based on sodium chloride availability; used in alumina refining and chemical industries
513.6(3)	Caustic potash; peroxides of potassium or sodium		✓			✓	✓	✓	.1		✓	- possible, based on local raw materials
513.6(4)	Oxides, hydroxides and peroxides of strontium, barium or magnesium		✓			✓	✓	✓	.1		✓	- magnesium potential promising, based on local sea water
513.6(5)	Aluminium oxide and hydroxide		✓			✓	✓	✓	.1		✓	- promising; recall 283.3 and 513.6(2)
513.6(6)	Artificial corundum		✓						.0			- not applicable
513.6(7)	Chromium oxides and hydroxides		✓			✓	✓	✓	.0		✓	- of limited interest at present; development subject to confirmation of larger deposits
513.6(8)	Tin oxides		✓						...			- not applicable
513.6(9)	Other inorganic bases and metallic oxides, hydroxides and peroxides		✓						.0			- not applicable
514.1	Metallic salts and peroxysalts of inorganic acids		✓			✓	✓		15.9		✓	- promising, based on expansion of chemical industry and available raw materials
514.2(1)	Sulfides (including polysulfides)		✓			✓	✓		.1		✓	- promising, based on development of available polysulphide deposits

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports^a (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
514.2(2)	Diothionites; sulfoxylates		✓			✓	✓		.0	✓	- promising, based on expansion of chemical industry
514.2(3)	Sulfites and thiosulfates		✓			✓	✓		1.3	✓	
514.2(4)	Sulfates (including alums) and persulfates		✓			✓	✓		1.5	✓	- promising, based on expansion of chemical and cement industries, and using local gypsum deposits
514.2(5)	Nitrites and nitrates		✓			✓	✓		.2	✓	- promising, based on expansion of chemical industry
514.2(6)	Phosphites, hypophosphites and phosphates		✓			✓	✓		8.9	✓	- promising, based on expansion of chemical industry, using local deposits
514.2(7)	Arsenites and arsenates		✓						...		- not applicable
514.2(8)	Neutral sodium carbonate (soda ash)		✓			✓	✓		2.5	✓	- promising, based on expansion of chemical industry
514.2(9)	Other carbonates and percarbonates		✓			✓	✓		18.8	✓	- promising, based on expansion of chemical and cement industries, and using local limestone
514.3	Other metallic salts and peroxysalts of inorganic acids (II)		✓						5.3		- not applicable
514.9(1)	Liquid air		✓			✓	✓	✓	...	✓	
514.9(2)	Hydrogen peroxide		✓			✓	✓	✓	.0	✓	- promising, based on development of chemical industry
514.9(3)	Phosphides								.0		- not applicable
514.9(4)	Calcium carbide		✓		✓		✓	✓	1.9	✓	- possible, based on local raw materials
514.9(5)	Other carbides		✓		✓		✓	✓	.2	✓	- prospects currently limited
514.9(6)	Hydrides, nitrides and azides, silicides and borides		✓						.0		- not applicable
514.9(9)	Other inorganic compounds, n.e.s.		✓						58.8		- not applicable
515	Radioactive and associated materials								2.2		- not applicable

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
521	Mineral tar and crude chemicals from coal, petroleum and natural gas								1.9			- not applicable
531	Synthetic organic dyestuffs, natural indigo and colour lakes								2.3			- not applicable
532	Dyeing and tanning extracts, and synthetic tanning materials								.7			- not applicable
533.1	Colouring materials, n.e.s.								6.6			- not applicable
533.2	Printing inks		✓			✓			3.8	✓		- promising, based on expansion of chemical industry
533.3	Prepared paints, enamels, lacquers, varnishes, artists' colours, siccatives (paint driers) and mastics		✓			✓			180.8	✓		- promising, based on expansion of chemical industry
541.1-.7	Medicinal products			✓					226.8			- not promising; technology restricted
541.9	Pharmaceutical goods			✓	✓		✓		24.5	✓		- joint ventures might be explored
551	Essential oils, perfume and flavour materials		✓						7.0			- not applicable
553	Perfumery and cosmetics, dentifrices and other toilet preparations (except soaps)		✓						232.5			- not applicable
554.1	Soaps			✓	✓				31.5	✓		- now produced, but limited scope for expansion
554.2	Surface-acting agents and washing preparations		✓			✓	✓		43.3		✓	- promising, based on expansion of chemical industry
554.3	Polishes, pastes, powder and similar preparations for polishing and preserving leather, wood, metal, glass and other materials			✓	✓				12.7	✓		- promising, based on expansion of chemical industry
561.1	Nitrogenous fertilizers and nitrogenous fertilizer materials (other than natural), n.e.s.		✓			✓	✓	✓	4.1		✓	- substantial investment committed

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports[a] (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
561.2	Phosphatic fertilizers and phosphatic fertilizer materials (other than natural) (including super-phosphates and basic dephosphorization slag)		✓			✓	✓	✓	3.0	✓		- promising, based on local phosphorite deposits
561.3	Potassic fertilizers and potassic fertilizer materials (other than crude natural potassic salts		✓						.5			- not applicable
561.9	Fertilizers, n.e.s.								4.5			- not applicable
571	Explosives and pyrotechnic products								21.5			- not applicable
581.1	Products of condensation, polycondensation and polyaddition (e.g., phenoplasts, aminoplasts, alkyds, polyallyl esters and other unsaturated polyesters, silicones)		✓			✓	✓		62.9	✓		- large investments committed; should concentrate production on those products for which technological obsolescence least likely, price elasticity high, and feedstock costs are a large fraction of total costs; interest should be concentrated initially on the development of these products, based on the use of olefins
581.2	Products of polymerization and copolymerization (e.g., polyethylene, polysterene, polyvinyl, etc. derivatives, coumaroneindene resins)		✓			✓	✓	✓	79.5		✓	
581.3	Regenerated cellulose, chemical derivatives of cellulose and vulcanized fibre								3.3			
581.9	Other artificial resins and plastic materials								103.6			
599.2	Insecticides, fungicides, disinfectants (including sheep and cattle dressing) and similar preparations		✓			✓			49.2	✓		- not too promising now; of possible interest as local petrochemical industry develops
599.5	Starches, inulin, gluten; albuminoidal substances; glues								36.4			- not applicable
599.6	Wood and resin-based chemical products								3.3			- not applicable
599.7(1)	Artificial waxes and prepared waxes, not emulsified or containing solvents		✓			✓			.7	✓		- promising, as a product of the refining industry; greater potential as petrochemical industry develops

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of imports* (1979)	Market GCC export	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy			
599.7(2)	Artificial and colloidal graphite		✓			✓			.1	✓	- promising
599.7(3)	Animal black								...		- not applicable
599.7(4)	Prepared glazings, dressings and mordants								.2		- not applicable
599.7(5)	Anti-knock preparations, etc.		✓			✓	✓	✓	23.0	✓	- non-lead additives; potentially big
599.7(6)	Prepared rubber accelerators		✓						.0		- not applicable
599.7(7)	Prepared culture media		✓						.1		- not applicable
599.7(8)	Charges for fire extinguishers		✓						4.4	✓	- promising
599.9(1)	Modelling pastes and dental impression compounds		✓						.3		- not applicable
599.9(2)	Activated carbon and activated natural mineral products		✓						1.4		- not applicable
599.9(3)	Ferro-cerium and other pyrophoric alloys		✓						.0		- not applicable
599.9(4)	Pickling preparations for metal surfaces, fluxes, etc.		✓						1.4		- not applicable
599.9(5)	Composite varnish solvents and thinners		✓			✓	✓		10.0	✓	- promising, as products of emerging petrochemical industry
599.9(9)	Other chemical products and preparations, n.e.s.		✓			✓	✓		85.4	✓	
Manufactured Goods Classified Chiefly by Material											
611	Leather		✓		✓				6.0	✓	- promising; recall 011
612	Manufactures of leather or of artificial or reconstituted leather, n.e.s.								5.9		- not applicable
613	Fur skins, tanned or dressed (including dyed)		✓						.4		- not applicable
621	Materials of rubber		✓						33.9		- not applicable

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
629	Articles of rubber, n.e.s.		✓	✓					387.4		- not applicable
631	Veneers, plywood boards, "improved" or reconstituted wood and other wood, worked, n.e.s.								304.5		- not applicable
632	Wood manufactures, n.e.s.			✓	✓				300.2	✓	- possible import substitutes, based on imported wood
633	Cork manufactures		✓						2.0		- not applicable
641	Paper and paperboard								174.4		- not applicable
642	Articles made of paper pulp, of paper or of paperboard		✓	✓	✓				190.0	✓	- promising; recall 251
651	Textile yarn and thread								22.7		- not applicable
652	Cotton fabrics, woven (not including narrow or special fabrics)								71.6		- not applicable
653	Textile fabrics, woven (not including narrow or special fabrics), other than cotton fabrics								970.3		- not applicable
654	Tulle, lace, embroidery, ribbons, trimmings and other small wares								85.9		- not applicable
655	Special textile fabrics and related products			✓	✓				52.1	✓	- processes generally labour intensive
656	Made-up articles, wholly or chiefly of textile materials, n.e.s.			✓	✓				307.3	✓	- processes generally labour intensive
657	Floor coverings, tapestries, etc.			✓	✓				370.9	✓	- processes generally labour intensive
661	Lime, cement and fabricated building materials, except glass and clay materials		✓		✓		✓	✓	954.2	✓	- promising, except 661.8(3), based on locally available deposits
662	Clay construction materials and refractory construction materials		✓		✓			✓	293.9	✓	- promising, based on locally available deposits
663	Mineral manufactures, n.e.s.								181.2		- not applicable

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
664	Glass		✓	✓	✓		✓	✓	170.5	✓	- promising, based on local sand deposits; recall 276.5
665	Glassware			✓	✓				80.1	✓	- promising, as above
666	Pottery			✓	✓				38.5	✓	- promising, recall 276.2
667	Pearls and precious and semi-precious stones, unworked or worked								21.8		- not applicable
671.1	Spiegeleisen								...		- not applicable
671.2	Pig iron (including cast iron)								26.1		- not applicable
671.3	Iron and steel powders, shot and sponge		✓			✓	✓	✓	3.3	✓	- substantial current production capacity
671.4	Ferro-manganese		✓			✓	✓	✓	.0	✓	- possible interest, based on 671.3
671.5	Other ferro-alloys		✓			✓	✓	✓	2.3	✓	- possible interest, based on 671.3
672	Ingots and other primary forms (including blanks for tubes and pipes) of iron or steel		✓			✓	✓	✓	110.4	✓	- promising, based on 671.3
673	Iron and steel bars, rods, angles, shapes and sections (including sheet piling)		✓			✓	✓	✓	1027.2	✓	- promising, based on 671.3
674	Universals, plates and sheets of iron or steel		✓			✓	✓	✓	296.0	✓	- promising, based on 671.3
675	Hoop and strip of iron or steel		✓			✓	✓	✓	6.1	✓	- of no current interest
676	Rails and railway track construction material of iron or steel			✓		✓	✓	✓	24.5	✓	- possible, based on 671.3
677	Iron and steel wire (excluding wire rod)		✓			✓	✓	✓	30.5	✓	- promising, based on 671.3
678	Tubes, pipes and fittings of iron or steel		✓	✓		✓	✓	✓	879.9	✓	- promising, based on 671.3
679	Iron and steel castings and forgings, unworked, n.e.s.		✓			✓	✓	✓	247.8	✓	- promising, based on 671.3

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market		Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC	export	
681.1	Silver, unworked or partly worked		✓	✓		✓	✓	✓	1.3		✓	- potential, based on development of local deposits
681.2	Platinum and other metals of the platinum group, unworked or partly worked								.1			- not applicable
682	Copper		✓	✓		✓	✓	✓	53.4		✓	- promising; recall 283.1
683	Nickel								1.5			- of no interest; recall 283.2
684	Aluminium		✓	✓		✓	✓	✓	140.7		✓	- promising; substantial investment; recall 283.3
685	Lead		✓			✓	✓	✓	6.9	✓		- of possible interest; recall 283.4
686	Zinc		✓			✓	✓	✓	8.3	✓		- of possible interest; recall 283.5
687	Tin								2.5			- not applicable
688	Uranium and thorium and their alloys								.3			- not applicable
689	Miscellaneous non-ferrous base metals employed in metallurgy								3.1			- of no interest, except magnesium
691	Finished structural parts and structures, n.e.s.			✓	✓				1269.8	✓		- promising; recall 671.3, 684, 686
692	Metal containers for storage and transport		✓	✓	✓	✓			129.5	✓		- promising; recall 671.3, 682, 684
693	Wire products (excluding electric) and fencing grills		✓	✓	✓				132.0	✓		- promising; some investment; recall 682, 684
694	Nails, screws, nuts, bolts, rivets and similar articles of iron, steel or of copper		✓	✓	✓				101.4	✓		- promising; some investment; recall 671.3, 682
695	Tools for use in the hand or in machines								200.3			- not applicable
696	Cutlery			✓	✓				43.4	✓		- not applicable
697	Household equipment of base metals			✓	✓				245.9	✓		- promising; some investment; recall 671.3, 682, 684

(Continued...)

TABLE 11-1: (Continued)

SITC Code	Commodity	Nature of commodity			Further processing		Potential intensity		Value of Imports* (1979)	Market	Remarks
		raw material	semi-finished	finished	simple	complex	capital	energy		GCC export	
698	Manufactures of metal, n.e.s.			✓	✓	✓			320.3	✓	- promising; some investment; recall 671.3, 682, 684, 685, 686

*The value of imports is in millions of US dollars; ... indicates "not available".

CHAPTER 12

INDUSTRIALIZATION IN THE GCC REGION: RINGS, LINKS, AND POLES

12-1. INTRODUCTION

The case for industrialization in the GCC region stems, in part, from the desire to create, over the longer term, an economic structure that would be much more balanced than the present one. Creating the new structure implies the need to increase the amount of value added to the region's natural resources through domestic processing, and to develop human skills through educational programs and working experience. There are other factors as well which argue for a more rapid pace of industrialization: the region's energy resources will eventually run out; the massive financial surpluses accumulated in recent years, and denominated in foreign currencies, are now in danger of deterioration; there is perceived to be an urgent problem of insecurity in food supplies; and there are strongly held expectations of high and rising levels of income among the people of the region.

The identification of specific objectives and constraints, the allocation of tasks, and the coordination of activities are integral parts of an industrial strategy. This chapter is concerned with defining the elements of a possible strategy for industrialization of the GCC region. The chapter examines objectives with respect to their consistency, identifies constraints, and indicates the major tasks ahead to ensure the realization of the objectives. The ultimate concern of the strategy would be with the consistency of the development process, so that the region's current enormous international purchasing power could be used to ensure the effective and efficient utilization of its resource base.

The Saudi plans summarize clearly the common objectives of the region. Their distinguishing mark is that development (material and social) is rooted in the ethical principles of Islam and the cultural values of the region. These principles[1] dictate the dedication of governments:

(i) to uphold Islam and to maintain its associated cultural values;

(ii) to assure the defense of the religion and the region, and maintain the internal security and social stability of the area's societies;

(iii) to continue balanced economic growth by developing the region's resources, by increasing the income from oil over the long term, and by conserving and augmenting the natural resource base and its utilization, thereby improving the well-being of all citizens and providing the economic strength to attain all the other fundamental goals of development;

(iv) to reduce dependence on the production of crude oil as the primary source of income;

(v) to develop human resources through education, training, and the raising of health standards;

(vi) to complete the basic infrastructure which is required for the attainment of these goals;

(vii) to balance free enterprise with the interests of the community at large.

Most countries in the region confront three principal constraints which affect the scope for balanced growth of their economies: their individual markets are small; they have very limited availability of arable land and water; and they have a limited supply of domestic labour. With the sudden increase in the price of oil in the wake of the Ramadan War of 1973, large financial surpluses were accumulated before any carefully worked-out plans for their utilization could be made, either through domestic absorption or through investment abroad. There was no previous experience on which to base estimates of future growth in the domestic absorptive capacity, and therefore there was no reason to question the economic rationality of generating a surplus of the size that was being created. Moreover, there were no assurances that oil prices, which quadrupled in just a few months, would actually be sustained at the new levels.

By the late 1970s and early 1980s, there was greater awareness of the risks involved in accumulating fixed-income-yielding assets in an inflationary world, of the probable weaknesses of the world oil market, and of the finite life-time of oil reserves. The last fact had particular impact on the GCC countries. The dramatic increases in their national incomes which resulted from the oil price adjustments still left their economies, aside from oil, in a general state of relative underdevelopment. The current high per capita GNP figures are clearly not sustainable under present conditions; the figures badly misrepresent the real situation, which involves the depletion of the oil reserves. At recent rates of utilization, these reserves will be exhausted within the life-time of the present generation in Qatar and Bahrain, of the children of that generation in the UAE and Oman, and of the grandchildren in Saudi Arabia and Kuwait. The means to a sustainable high level of income is the creation of a much more diversified economy than now exists, and one which does not depend on oil for its continuation and growth.

12-2. THE OPTIONS

Were oil supplies everlasting, and the demand for oil strong and continuous, economic diversification would be pointless. The governments of the region would instead need only to ensure the distribution of oil revenues among the population. However, this is not the case. Oil reserves are finite and non-renewable, and the demand for oil is not stable. The GCC countries have but a limited time in which to make use of oil revenues to create a viable economy that will sustain a relatively high level of income after the end of the oil era. Such an economy may be achieved only through a long-term program of maintaining a high ratio of investment to non-oil GNP while at the same time sustaining a major effort to enhance the skill level of the domestic labour force.

High ratios of investment to non-oil GDP in the GCC countries are possible with little if any sacrifice of present consumption. Savings have not been generated by foregoing consumption, but have accrued principally from the oil sector in such amounts that the funds available for investment have, in recent years, exceeded the physical and economic possibilities for utilizing them. This is the well known constraint of limited absorptive capacity. But this constraint is not exogenous. It may be relaxed through the augmentation of markets, through intercountry policy harmonization, and by extending the regional boundaries or "rings" of production beyond the GCC area itself. Absorptive capacity may also be extended by a program of major capital investments undertaken in a number of different industries simultaneously, thereby taking advantage of backward and forward linkages in production sequences. The nurture and promotion of "growth poles" is yet another mechanism for increasing domestic absorptive capacity and the potential of the economy for balanced growth. Each of these strategies will be considered separately. However, they all share a common aspect; they all assume that the supplies of complementary inputs -- particularly skilled labour and capital infrastructure -- can be increased, and perhaps quite sharply. If the supply of labour from domestic and foreign sources is limited, or if it is deemed desirable to control it, then some hard choices must be made. On economic grounds alone, the criterion which might be advanced is that the marginal product of a foreign worker must exceed his wages plus the social cost of maintaining him in the region, but this may not be the only criterion to be taken into account.

The regional boundaries of production will be considered first, having regard for the new Economic Agreement within the GCC framework.

12-3. REGIONAL RINGS

Political boundaries in the GCC region, the much larger Arab region or, for that matter, the Third World as a whole, do not necessarily correspond with optimum geographic boundaries from an economic point of view. Thus the development of closer economic contacts among countries may be of potential mutual benefit.

Increasing trade among the member countries of the GCC is not the only objective of their regional economic association. The examination of their trade flows (in Chapter 3) revealed that only a small part actually occurs within the GCC region itself. The member countries are, at present, too similar for much trade to take place. Indeed, the end products of each are generally competitive rather than complementary with those of others in the region. Thus the exportable portion of each country's output must find its market outside the immediate region while a wide range of commodities must come from sources entirely outside the region, or be done without.

Little economic complementarity prevails within a region comprised entirely of developing countries, such as those in the GCC region, and thus the basis for mutually advantageous trade tends to be weak. But complementarity can become a fact in the future. With the emergence of industrial activity within the region, greater complementarity will likely result and this would encourage a larger volume of intra-regional trade. At the same time, the introduction of new industrial activities may be long delayed, or even found to be impossible, unless a large enough market can be assured for the end products. There is therefore a strong case for the establishment and promotion of regional trade arrangements -- not to yield immediate gains from the exchange of goods available in the prevailing economic circumstances, but rather as a means to promote and speed economic development itself. Then, as economic development proceeds, and member countries achieve higher levels of economic activity generally, they will find themselves engaged in more extensive intra-regional trade. The small economic size of most countries of the GCC region has restricted their independent economic development. But with the extension of the boundary of production to include the whole GCC region, industrialization opportunities will increase and this, in turn, will augment the possibilities for increased specialization. Put simply, the regional market, by making intra-regional trade possible, may help to encourage new enterprises which would, in turn, increase intra-regional trade. This is a dynamic process that feeds on itself; once put in motion, it generates its own momentum.

Economic interaction at the regional level can also take place through collaborative projects. Some projects are not physically possible without the cooperation of two or more countries in the region while others may not be economically viable without such cooperation. In the petrochemical field, in particular, the minimum size and bargaining strength necessary to penetrate international markets place heavy emphasis on the harmonization of investment and production at the regional level. It is also evident that cooperation is necessary to encourage specialization and avoid duplication in the processing of mineral resources. Joint projects in aluminum, steel, and copper are already emerging. Generally speaking, a project should be purused at the regional level when the geographic distribution of resources makes pooling necessary (e.g., the iron and bauxite deposits in Saudi Arabia are processed in the UAE and Bahrain); when individual national markets are too small to permit an economic scale of operations (e.g., the petrochemical complexes in Saudi Arabia); and when particular facilities can best be created and managed on a regional basis (e.g., the dry docks in Bahrain).

It must be realized that when a facility intended to serve the region as a whole is situated entirely in one country, other countries may resent the location. However, such impediments may be lessened substantially if the joint financing of projects results in a continuing flow of shared benefits to all participating nations. Furthermore, joint projects may be undertaken to the benefit of all the countries.

Another area for possible economic cooperation is that of currency and exchange rates. Regional currency clearing arrangements may not be needed in the GCC region, given the abundant supplies of foreign exchange of each member country. However, the multiplicity of exchange rates complicates trade and economic interaction generally. A single currency area might help to foster intra-regional trade. The European Payments Union (EPU), for example, was an important mechanism in sustaining the EEC and other European economic cooperative efforts. Although it is true that a currency arrangement can do no more than accommodate trading which is economically justifiable, it can nonetheless provide considerable encouragement and support for such trade.

The GCC region can be viewed as a primary ring of production, and it can benefit from the expansion of its economic interactions with rings beyond its own boundaries. A close outer ring is that of the Arab region at large. Trade relations with this ring are important, but not extensive. The Arab ring provides a large potential market for GCC products, a significant source of resources (both physical and human), and a lucrative outlet for investment. In fact, these three aspects could be related in a deliberate and systematic manner to activities within the GCC region: Sudan could complement food security; Mauritania could provide the high grade iron deposits for the beneficiated ore required by the direct reduction technology of iron production; Lebanon could provide the entrepreneurial skills for the manufacture and marketing of petrochemical final products; and Egyptian, Iraqi, and Syrian manufacturing experience could be marshalled for the mutual benefit of all the parties concerned.

There is also a ring of non-Arab Third World countries near the GCC region. This ring extends east to the Asian sub-continent, and includes Pakistan, Bangladesh, India, and Sri Lanka, and west and south to include much of Africa with its rich mineral deposits. The privileged processing position of the GCC region, given its abundant energy, capital, and complementary feedstocks, calls for a thorough and futuristic stock-taking of the potential of this outer ring for enriching the region's interactions with these countries. There has already been significant progress in this direction, as noted in previous chapters. However, there is much scope for the extension, expansion, and deepening of this promising South-South cooperation; such cooperation could be formalized and the areas in which it might be undertaken could be comprehensively and systematically considered.

12-4. GROWTH POLES

One of the most fundamental policy issues that policy makers in the GCC region must decide is whether to attempt a massive, generalized, "big push" development effort or to concentrate upon raising growth rates in selected key economic sectors. It has already been argued that the GCC region needs to maintain a massive investment program in the non-oil sector. But does this mean that investment expenditures should be spread over many sectors, with large investments in each? Those who favour such an approach usually stress the indivisibility of capital and profit interdependencies that exist among different development projects as the main justifications. The indivisibility of capital inputs leads to production conditions in which unit costs, instead of being constant at all output levels, decrease significantly as output expands until the scale of production becomes sufficiently large. Cost curves in industries that make up the social overhead capital of the economy, such as transportation, communications, and power, behave in this fashion. But so also do cost curves in many manufacturing industries. Since markets for manufactured products are generally so small in small economies that unit costs of production are above effective demand price, these items may not be produced domestically. To encourage their production it may be necessary to bring about a large increase in demand and this, in turn, may be achieved through a massive investment program that capitalizes on inter-industry demands. There may also be significant external economies associated with the agglomeration of interconnected activities.

While the logic of this strategy is strong, its empirical relevance rests on special assumptions about supply elasticities -- assumptions which are far from satisfied in the GCC region. For one thing, there is a severe shortage of manpower and skills. The supplies of labour, technology, and natural resources are not perfectly elastic in the region, and factor prices and cost curves would therefore rise at the same time as efforts to increase demand were being undertaken. Indeed, the industrial experience of the GCC region indicates clearly that there are crucial shortages of entrepreneurs, managers, technicians, and skilled workers of all sorts, and even of unskilled workers, and that any massive investment program puts a tremendous strain on these resources. This does not suggest that nothing can be done. It implies that policy-makers must be careful and selective. There are particular industries and sectors in which intensive investment efforts can pay high dividends by eliminating bottlenecks and stimulating higher investment rates in complementary industries. In these leading sectors (growth poles), investment complementarities (particularly intra-regional ones) and resource supply elasticity can be effectively utilized.

The region now has an adequate and well-functioning infrastructure without which industry would not be able to survive. All seaports have been expanded and are expected to show excess capacity for some time to come. Highway networks have been built to high standards and on such a large scale that the scope for additional investments in the near future is very limited. Large housing complexes are now completed. Large new hospitals are either completed or will be completed in the near future. Very large infrastructure facilities for industry have been completed, particularly in Saudi Arabia, Kuwait, and the UAE. However, the development of the infrastructure has, to some extent, been divorced from the overall industrialization effort. These two activities need now to be brought together on more solid and better coordinated basis.

Chapter 11 identified a number of industrial activities which appear promising in the regional context. In this chapter we consider these activities in terms of their growth potential. Five growth poles can be identified. Of these, four will receive special attention in this chapter: the food pole, the chemicals pole, the mineral pole, and the capital goods pole (The fifth, the energy pole, has already been discussed in detail in Chapter 7.)

First, poultry production, fish and fish products, and fruit and vegetable canning were identified as promising in terms of demand and technology. This is the food pole.

Second, production of hydrocarbon-based chemicals is well suited for the area. These products are capital-intensive and energy-intensive and their feedstocks are plentiful and cheap. (Evaluated at its opportunity cost, the price of flared gas is zero.) Production should be concentrated on mature products (basic and intermediate petrochemicals) whose demand is price-sensitive, whose production technology is stable, and whose feedstock costs account for a large proportion of total production cost. It is in these products that comparative advantage is highest in the region; producers could afford to make such price discounts as are necessary to capture a sizeable proportion of the world market. Olefins, which are primarily gas-based, appear to provide the best initial products. However, the petrochemical growth pole is likely to expand and develop as it gains market and technological experience. Likely directions of expansion are into aromatics and final products, particularly downstream operations involving further processing of the basic and intermediate products of the existing complexes. Joint ventures with TNCs will continue to be necessary to share the risks of a technologically highly complex industry in an uncertain world market. Care needs to be exercised, however, in order to match subsidies to objectives and results. Efforts must also be directed towards the encouragement of domestic entrepreneurial skills, and serious efforts need to be expended on joint ventures to undertake both marketing and further processing in developing countries.

Third, a set of products coalesce around the mineral growth pole. Iron is already produced in Qatar and there are steel rolling plants in Saudi Arabia and the UAE. In addition, an iron pelletizing plant is under construction in Bahrain and an integrated sponge iron and steel plant is being contemplated in Saudi Arabia. The direct reduction method holds great promise for the region. Not only does it utilize natural gas instead of coke as a feedstock, but it is energy- and capital-intensive, and the minimum economically efficient scale of production is relatively small. Thus there is no reason that the region could not be self-sufficient, and even export-oriented, in iron and steel. There are, as we have seen in Chapter 8, some iron ores in Saudi Arabia that could be blended with imports, particularly from within the Arab ring (for example, from Mauritania).

Equally promising are the refining of alumina and the smelting of aluminum. Again, these activities are capital- and energy-intensive, and they utilize some local feedstocks. Furthermore, the area is strategically located near outer-rings rich in these deposits (Guinea, in Africa, has one-third of the world total deposits of bauxite).

Copper production is also promising. There is already a copper smelter in Oman, but its scale is small. Expansion of this smelter could be considered.

Thus the mineral pole is growth-oriented and holds good promise for expansion. Its expansion should involve greater vertical integration than has hitherto been the case, extending from the mines through the refineries and smelters to the final products, and extending also the outer rings.

Two other poles hold special promise: an energy growth pole which includes refining and the liquefaction of natural gas, and a capital goods pole. Since the energy pole has already received sufficient attention, we turn now to the capital goods pole.

12-5. CAPITAL GOODS GROWTH POLE

Aside from natural resource-based industries and the other growth poles mentioned above, there are many industries which are likely to be viable candidates for cooperation among GCC member countries. One such area is in the field of heavy engineering industries which we refer to here as the capital goods pole. These industries are characterized by quite heavy capital investment, highly skilled manpower, and a long maturation period. Another outstanding characteristic is the existence of a large number of links between their output and that of other productive activities (forward and backward linkages). The linkages of these industries lend themselves also to split production whereby certain products produced in one country of the GCC can be used as inputs in other plants located in another GCC country.

A review of the structure of manufacturing output in the GCC member countries reveals that more complex and integrated activities in the engineering industries have only recently been given attention by some member states. The lack of financial resources, the limitation of the market at the country level, and the absence of a cooperative outlook among the member countries, may have inhibited the establishment of such industries.

With the exception of Saudi Arabia in the case of a limited number of industries, the GCC member countries individually will not be able to develop viable industries in this field because each member country, when operating alone, lacks one or more factors necessary for the development of viable and dynamic engineering industries. Thus it would appear that in the GCC countries collectively, the high level of demand for capital goods which has been created by their ambitious development programs can serve to encourage the rapid expansion of the capital goods industry within the region. As an indication of the magnitude of demand, we note that the region's import of engineering products increased from 1,392 million US dollars in 1973 to 13,420 million in 1978.[2] During this period, the member countries spent an average of close to 14 percent of their GDP on imports of such products. Present indications suggest that such a trend will continue for some time to come. We therefore take much of the rest of this chapter to provide a preliminary exploration of certain capital goods industries which hold out some promise as possible candidates for expansion and for import replacement, and whose development would require cooperation among the GCC member countries.

Our intention is not to provide an exhaustive list of possibilities. Instead, we attempt to provide suggestions for the sorts of industries which would seem to build on the development of the region and, in turn, would encourage further development. The capital goods manufacturing industries which we discuss produce: (i) telecommunications equipment; (ii) electronic products; (iii) electric power equipment; (iv) telephone and power cables; (v) machinery and equipment for the petrochemical industry; and (vi) construction and transportation equipment.

Telecommunications Equipment

Telecommunications equipment includes a wide range of products extending from simple ones, such as telephones, to complex ones, such as broadcasting equipment, radar, microwave equipment, exchanges, telex machines, and others. However, since the major telecommunication services in the GCC member countries are likely to remain concentrated in telephones and telex, they are the ones of concern to us here.

Many problems face the establishment of a telecommunications industry, including the acquisition of technology and the need to keep up with new products. At the same time, such an industry would stimulate the development of other strategic industries, notably the electronics industry. Furthermore, a major prerequisite to the success of this industry at the GCC level is close cooperation among the governments of the region, since the industry has strong links with the government telecommunication authorities.

The growth of demand for telephone and telex equipment has been projected for the GCC member countries in Tables 12-1, 12-2 and 12-3, and is summarized below:

Average Annual Demand in the
GCC Member Countries

	1981-85	1986-90	1991-95
Telephone Exchange Lines	252,000	511,000	610,000
Telephone Instruments	327,000	664,000	792,000
Telex Exchange Lines and Telex Machines	4,500	5,980	n.a.

The projections indicate that the market of the GCC region could now absorb about 250,000 telephone exchange lines per year, which is considered by international manufacturers as the current minimum viable scale of production. In 1980 the ECWA/UNIDO Industry Division concluded that a production level of 250,000 lines per year would be economically viable in the ECWA region. Fixed capital per plant was estimated at about $85 million with working capital at about $24 million.

The trend towards electronic digital exchanges will continue in telephone systems, and future developments will reflect mainly improvements in electronic intermediate devices. The manufacturing, however, covers both hardware and software production, and should be pursued in collaboration with international manufacturers. A detailed feasibility study would be required.

The production of telephone instruments is simple compared to other telecommunication products, and does not require foreign technical assistance since most of the needed skills are available locally. The minimum annual scale of production for an integrated plant is about 200,000 instruments per year. Such a level of output could easily be absorbed in the region. Alternatively, assembly-type operations of smaller plant capacities (e.g., 50,000 instruments yearly) could be produced at the national or at the GCC level. The major justification for manufacturing telephone instruments in the GCC region is to take advantage of backward linkages by manufacturing the components too. However, it may be that a central activity could feed assembly-type operations at a country level. A comparative study might be conducted to compare the advantages of an integrated industry against the alternative of several assembly plants which are supplied from one central facility.

The market for telex machines, even on the GCC regional level, is not adequate to support a minimum economic scale of about 100,000 units assembled annually. Therefore, it should not be considered for further study at the present time.

Electronic Products

Electronic products cover a wide range, from the components to end-use products. Examples of electronic components include diodes, transistors, integrated circuits, resistors, and relays. Among the examples of end-use products are telecommunication products (such as exchanges, telephone instruments, and telex), entertainment products (such as television sets, stereo and video equipment), office equipment (such as electronic typewriters, computers, and copiers), defence products, and instrumentation and control. (Each example itself represents a wide variety of continuously evolving products.)

The market demand for electronic equipment in the GCC region has been growing at a very high rate, especially in business products.

We illustrate with two examples from the experience of Kuwait: sales of electronic calculators increased about 77 percent per year between 1975 and 1978; sales of general office equipment increased about 34 percent each year over the same period.

Electronic date processing systems, of which computers (micro and mini) represent the major components, are likely to be the major area of future demand. The market is large, dynamic, and growing, but it is difficult to anticipate the demand, partly for lack of information. It would be extremely useful to conduct a study to assess the market prospects, and to identify specific areas of interest within the electronic manufacturing industry, including, especially, the manufacturing of microcomputers.

Electric Power Equipment

The electric power generation programs in the GCC member countries are massive and dynamic. Tables 12-4 and 12-5 present the projected yearly additions of generation and transformer capacities in each of the member countries; the projections are summarized below for the region as a whole.

Average Annual Increase in Capacity in the
GCC Member Countries

	1981-85	1986-90	1991-95
Installed Generation Capacity (MW)	1,451	2,610	2,105
Transformer Capacity (MVA)	7,637	14,165	11,349

The generation programs are predominantly thermal, steam and, to a lesser extent, gas. Nuclear power generation is not likely to become significant in the next two decades.

Equipment for electric power generation and distribution includes generators, turbines, transformers, motors, switchgears, and capacitors. Turbines and generators are the heart of the generation programs, and are also the most costly items. (Their combined cost amounts to about one third of the total cost of the thermal power plants.) Transformers are also relatively expensive.

The projected demand for turbines and generators in the GCC region over the next decade or so is at about the output level associated with a 2000 MW manufacturing plant. That is about the minimum plant size which international manufacturers consider to be economically viable. None of the countries alone could absorb the output of a plant this size, even by the year 2000.

If production in the GCC is to take place, it would be most important to standardize the sizes of the generating units. Available evidence suggests that most plans call for steam units with capacities of 100, 150, and 300 MW, and gas turbines units of 50 MW are the most likely ones. In addition, steam turbines will be required for electric power generation in industry, but in smaller sizes.

The required production machinery and equipment is quite expensive and complex and the technology, though stable, is also complex. It should be mentioned that the machinery required for producing 300 MW units, for example, is also capable of producing larger units up to 500 MW units, say. Moreover, the same machinery can produce industrial turbines and generators as well as a variety of motors.

Probably the first step in this area should involve the manufacture of generators, and a feasibility study could be done.

Referring to the projected demand for transformers, it is seen that the regional market for small distribution transformers (0.25 - 1.25 MVA) and medium power transformers (6 - 40 MVA) could, even now, absorb the output of a 3000 MVA manufacturing plant, the size of plant generally considered by international manufacturers to be the minimum that is economically viable. As for large power transformers (75 - 200 MVA), the projected markets could absorb the output of a manufacturing plant of the minimum viable size of about 6000 MVA starting in about 1986.

From a manufacturing point of view, various sizes of transformers could be produced in the same factory. Furthermore, transformers for instruments, industrial uses, and other purposes could also be produced in the same factory. However, the efficient production of transformers in the region requires extensive preparations relating to the standardization of transformer sizes and the evaluation of existing transformer factories, among other things.

In Saudi Arabia, several companies were licensed in 1979 and 1980 to manufacture transformers. Their total capacities exceed 3000 MVA. Details on size are not known, but it is most likely that all these factories intend to produce small distribution transformers. Coordination of the output of these plants, as well as of those intended to be erected in the UAE, is essential at this stage. A study should be carried out to evaluate the existing licensed facilities in order to formulate a general plan for the manufacture of transformers in the GCC region.

Telephone and Power Cables

In the expansion of the telephone system, the direct exchange lines, as well as the trunk networks, will probably be based on cables. The technology for manufacturing telephone cables is not complex, nor are the skills required at the shop floor level of a very high order. However, the raw materials and the production management skills must be of high quality. We note that some raw materials, such as polyethylene and polyvinyl chloride, will soon be available from the petrochemical complexes in the region. The facilities for manufacturing telephone cables which now exist in the member countries are in plants which have a wide product mix, including the production of power cables. Thus the manufacture of telephone cables cannot be considered in isolation from that of power cables.

Many suppliers of power cables have been established in connection with the massive electrification programs undertaken in the GCC member countries. Bahrain has an operating cable manufacturing plant with a capacity of 14,000 tons per year, producing mainly all-aluminum conductors and steel-enforced aluminum cable (ACSR). The Gulf Cable and Electrical Industries plant in Kuwait produces low tension (LT) cables of various sizes, in addition to telephone cable. The production is projected to reach 20,000 tons/year. Plans are under way to manufacture cable joints as well as medium voltage cables. Six companies were licensed in Saudi Arabia in 1980 to produce cables and wires. Their total licensed capacity exceeds 90,000 tons/year. Details as to the type and voltage are not available, but over 30,000 tons/year were intended to be insulated overhead aluminum cables. It is also reported that a small plant producing aluminum conductors is in operation in the UAE.

Although detailed information about the operating plants in the region is not available, it is likely that they all produce low tension cables, telephone wires, and bare aluminum conductors. The demand for high tension cables is still, by and large, met through imports. There would appear to be considerable scope for coordination between the existing and planned production units in order to avoid duplication and to achieve specialization of each plant in certain products, and thereby to improve performance and facilitate the creation of plants for manufacturing medium and high tension cables as well as telephone cables. A detailed study should be conducted for this purpose.

Machinery and Equipment for the Chemical and Petrochemical Industries

Included in this group are process vessels, storage tanks, bins, heat exchangers, furnaces and kilns, filters, pumps, compressors, and boilers. The demand for machinery and equipment of this sort depends primarily on the development of such end-use industries and processes as gas extraction and processing, oil refining, fertilizer production, petrochemical production, and water desalination. According to surveys reported in the Hydro-Carbon Processing Journal in 1978, the cost of fabricated static equipment (such as vessels, furnaces, heat exchangers) represented 37 percent of the total cost of battery limit of the sorts of plants mentioned above, except those for water desalination.

The massive hydro-carbon and desalination projects planned by the member countries over the next two decades ensure a market for such equipment which is certainly large enough to justify minimum plant size. However, one of the major problems in developing such an industry is the tendency on the part of the industrial development authorities to adopt the short-cut approach of "turn-key" projects, which makes it difficult for local manufacturers to break into the domestic market. Many companies in the GCC member countries have faced this problem. The case of the Kuwait Industrial Refinery Maintenance and Engineering Company (KREMENCO) is a good example. Although the company is well established and possesses all the necessary facilities to manufacture heat exchangers, it has been unable to market such equipment. In consequence, the activities of the company have been confined mainly to repair and maintenance work, as well as some fabrication of metal products.

The Arabian Ship Repair Yard in Bahrain is now underutilized. For this reason, the Kuwait Desalination Plants Fabrication Company intends to enter into a joint venture with it to fabricate the metal products (such as heat exchangers) required for desalination plants. The Kuwait Desalination Plants Fabrication Company, which has been licensed since 1979, is considering the fabrication and manufacture of static parts for desalination plants. At this time, it is licensed to sell only in Kuwait.

In Saudi Arabia, many companies have been licensed to produce pipes and heat exchangers; their licensed capacities to produce pipes exceed 120,000 tons/year.

In view of the difficulties faced in marketing heat exchangers, it is recommended that a detailed examination be carried out of the conditions which would ensure the satisfactory development of industries to produce fabrication facilities. Special attention might be given to the Kuwait Desalination Plants Fabrication Company, and to the steps which would allow it to expand from the national to the GCC level.

Construction and Transportation Equipment

Construction equipment includes excavators, loaders, scrapers, graders, mixers, cranes, and forklifts, as well as other types. Transportation equipment encompasses a wide variety of vehicles, but we are concerned here only with heavy vehicles which are broadly similar to construction equipment. The manufacturing of large-scale vehicular equipment for these industries is obviously closely interlinked in many aspects. For example, there are common supply sources for many inputs. The linkages could be developed at the level of components and or the level of sub-assemblies.

While the demand for large vehicular equipment in the GCC member countries is huge, it involves many types and makes. It would be difficult to organize an industry to encompass all of these types.

Alternatively, consideration might be given to the development of manufacturing capacities for the components and sub-assemblies to cater to the repair needs of these types of equipment. The common components and sub-assemblies could include diesel engines, pistons, liners, rings, crankshafts, camshafts, fuel line equipment, waterpumps, radiators, valves, wheels, dynamos, startermotors, seals, etc.

The capital goods pole may have a promising future if and when feasibility studies are undertaken to initiate the development of the most viable lines.

Linkages

Pointing to the potentialities of a more selective approach to growth does not mean that we can simply forget about balance in the development process and functions. Obviously, we cannot ignore either the technical input-output relations of production or the demand patterns of the ultimate consumers. As more people are brought into industry, (largely from outside the region, in the GCC context), domestic agricultural output must be expanded or food imports increased. Any successful development program must proceed in a way that maintains a balance among the different poles and recognizes their inter-relationships. But this poses a new question: is there any hierarchy to these poles and, if so, in what way do they interact? The table below suggests the pattern of input-output relationships among the five areas of industry which we have identified as "growth poles".

Input-Output Relationships Among the Growth Poles

Outputs Inputs	Food	Petrochemicals	Minerals	Capital Goods	Energy
Food	✓				
Petrochemicals	✓	✓	✓		
Minerals		✓	✓	✓	
Capital Goods	✓	✓	✓	✓	✓
Energy	✓	✓	✓	✓	✓

The food pole depends on every other pole, whereas the other poles do not depend on it, in a supply sense. Petrochemicals depend on all other sectors except food, and supply their output primarily to food and other petrochemicals. Mineral industries depend on all sectors except food and contribute primarily to petrochemicals, other mineral industries, and capital goods. Capital goods contribute to every sector but depend on only the last three. The energy sector contributes to all sectors but depend mainly on the last two.

The table above suggests that if priorities were to be set, the energy and capital goods poles should be accorded top rating since their existence promotes all other sectors and they depend least on other sectors. (We note again that the development of the costly capital goods sector need not be at the expense of consumption in the region.) At the same time, the information in the table also suggests that when the growth of any one pole is encouraged, care must be exercised to link it to the growth in the poles which supply it, as well as to those into which it feeds its output. The outputs need not all be produced domestically, but the imports and exports need to be coordinated.

FOOTNOTES FOR CHAPTER 12

1. Third Development Plan, 1980-1985, Ministry of Planning of the Kingdom of Saudi Arabia, 1980.

2. Bulletin of Statistics on World Trade in Engineering Products, UN/ECE, 1978.

TABLE 12-1: PROJECTED AVERAGE ANNUAL DEMAND FOR TELEPHONE EXCHANGE LINES

	1981-85	1986-90	1991-95
Bahrain	7,000	10,000	16,000
Kuwait	48,000	108,000	160,000
Oman	11,000	22,000	42,000
Qatar	6,000	11,000	12,000
Saudi Arabia	140,000	300,000	300,000
UAE	40,000	60,000	80,000
Total, GCC Region	252,000	511,000	610,000

SOURCE: The Viability of Establishing a Regional Telecommunication Industry in the ECWA Region, Joint ECWA/UNIDO Industry Division, 1980.

NOTE: These projections are comparable to the projections of ITU incorporated in Middle East and Mediterranean Telecommunication Project, Master Plan, Final Report, December 1978.

TABLE 12-2: PROJECTED AVERAGE ANNUAL DEMAND FOR TELEPHONE INSTRUMENTS

	1981-85	1986-90	1991-95
Bahrain	9,000	13,000	21,000
Kuwait	62,000	140,000	208,000
Oman	14,000	29,000	54,000
Qatar	8,000	14,000	15,000
Saudi Arabia	182,000	390,000	390,000
UAE	52,000	78,000	104,000
Total, GCC Region	327,000	664,000	792,000

SOURCE: See Table 12-1.

TABLE 12-3: PROJECTED AVERAGE ANNUAL DEMAND FOR TELEX EXCHANGE LINES AND TELEX MACHINES

	1981-85	1986-90	1991-95
Bahrain	400	680	n.a.
Kuwait	600	1,000	n.a.
Oman	560	780	n.a.
Qatar	340	420	n.a.
Saudi Arabia	1,600	2,400	n.a.
UAE	1,000	700	n.a.
Total, GCC Region	4,500	5,980	n.a.

SOURCE: Middle East and Mediterranean Telecommunication Project, Master Plan, Final Report, ITU, December 1978.

TABLE 12-4: PROJECTED AVERAGE ANNUAL DEMAND FOR INSTALLED GENERATION CAPACITY (IN MEGAWATTS)

	1981-85	1986-90	1991-95
Bahrain	76	127	83
Kuwait	325	499	477
Oman	14	14	16
Qatar	62	62	44
Saudi Arabia	750	1,548	1,164
UAE	224	360	321
Total, GCC Region	1,451	2,610	2,105

SOURCE: See Table 12-1.

TABLE 12-5: PROJECTED AVERAGE ANNUAL DEMAND FOR TRANSFORMERS

	1981-85	1986-90	1991-95
A. Small Distribution Transformers (.25 - 1.25 MVA)			
Bahrain	91	156	100
Kuwait	390	600	573
Oman	17	17	20
Qatar	75	76	52
Saudi Arabia	891	1,860	1,398
UAE	269	450	384
Total, GCC Region	1,733	3,159	2,527
B. Medium Power Transformers (6 - 40 MVA)			
Bahrain	182	302	199
Kuwait	655	1,008	955
Oman	33	33	40
Qatar	150	149	104
Saudi Arabia	1,184	2,512	1,865
UAE	449	709	643
Total, GCC Region	2,653	4,713	3,806
C. Large Power Transformers (75-200 MVA)			
Bahrain	-	-	-
Kuwait	515	792	766
Oman	-	-	-
Qatar	-	-	-
Saudi Arabia	2,378	4,931	3,733
UAE	358	571	517
Total	3,251	6,294	5,016

SOURCE: See Table 12-1.

PART IV

CONCLUSIONS

CHAPTER 13

SUMMARY AND RECOMMENDATIONS

13-1. INTRODUCTION

A major goal of the six member countries of the Gulf Cooperation Council is to make effective use of their current oil-based wealth so that future generations will also be able to enjoy high standards of living. It is unlikely that this goal could be realized by chance. Instead, the careful implementation of well-conceived plans is essential so that the economy of the GCC region can be diversified over the next few decades before the oil supplies are depleted.

The major purpose of this study has been to provide a stock taking of the natural resource base of the region. Without such a stock taking, the essential base of information on which policy proposals and discussions might proceed is critically incomplete. And this report represents the first attempt to provide consolidated information on the resource base of the region as a whole. A secondary purpose has been to make some necessarily tentative recommendations, based on the stock taking, as to the appropriate broad focus and emphasis of industrial policies over the years ahead. These recommendations are squarely based on the information that we have put together about the resources of the region.

13-2. SUMMARY

This report is organized into three parts, in addition to this, the concluding one. Part I is concerned with what is essentially background material, providing a context for the study. Part II constitutes the heart of the report. It consists of seven chapters, and provides a survey of the natural resource base of the region. Some possible uses of the resource base are the topic of Part III. We turn now to a brief summary.

Chapter 1 places the current situation in its historical context. Prosperity in modern times is a recent phenomenon in the region. In the mid- to late-1970's, the oil revenues increased to such an extent that they exceeded the capacities of several of the countries in the region to make effective current use of them. It is a rare experience for countries to find themselves unable to utilize all the resources available, and more, to facilitate their efforts at development -- but that is the problem which faced the countries in the Arabian Gulf in the 1970's. In consequence, plans had to be devised to store the surplus wealth so that it would still be available when it could be put to effective use, other plans had to be made for its eventual use and, of course, current expenditures had to be made so that the whole process of accelerating the pace of development would get underway, and the absorptive capacities of the several economies would be expanded.

Because of the great similarities among the countries of the GCC in both their resource bases and their stages in economic growth, as well as in their economic objectives, the several countries individually have often undertaken similar development projects. In many instances that has been a sensible and appropriate thing to do. However, in other cases it has led to undesirable duplication of facilities and to mutually harmful competition for the personnel and equipment necessary to implement the plans. It was, in part, the recognition of the potential gains which could be realized from the coordination of their development plans which culminated in the creation of the Gulf Cooperation Council in February 1981.

Of particular importance for our purposes here is the Economic Agreement signed in June 1981 by the GCC members. It is a comprehensive document which provides the framework and the mechanisms of coordination and integration of economic activity in the region. The Agreement establishes, among other things: free trade in the region with a common tariff for goods imported from outside; free movement of people and capital within the region; pooling of bargaining power when dealing with trading partners outside the region; a common oil policy; and a coordinated policy of industrialization involving the harmonization and eventual complete integration of development plans. The Agreement is a flexible and dynamic one, with various aspects to take effect as conditions warrant. Its emphasis on the coordination of investments, of development effort, and of complementary activities is designed to enhance the industrial growth potential of the region by rationalizing production and encouraging intra-regional specialization.

With the creation of a larger regional market and the integration and harmonization of development plans, the members of the Council have created an opportunity to make more effective use of their collective resource base as a means of promoting industrialization. Economic activities need not be limited to the extraction of natural resources, but can instead extend to their processing as well. Such resource-based industrialization is potentially an effective means of transforming an economy. However, such extension must be promoted selectively, and with care. The right decisions will direct the scarce supply of skilled labour in appropriate ways, will use precious time to advantage, and will create a sense of accomplishment which will give impetus to further accomplishments.

In broad terms, resource-based industrialization should involve the promotion of industries in which the region has a clear comparative advantage, and the discouragement of those industries in which it has not. In one sense, the purpose of the report has been to assess the resources of the region in order to suggest where its comparative advantages lie.

Background material relating to economic activity in the GCC region is provided in Chapters 2 and 3. Chapter 2 is entitled "An Overview of the Economy of the GCC Region," and Chapter 3, "Intra-Regional and External Economic Relationships." The overview starts with brief discussions of the region's natural and human resources. The natural resource base is, as stated, the main concern of the study, and the topic of the several chapters of Part II, summarized below. The human resources must nonetheless be recognized as placing constraints on the rate at which the region can develop. It was noted that a large fraction of the population is now foreign, attracted to the region by the high wages associated with the rapid pace of development. The population is also a relatively young one. Its educational level, and that of the labour force, while improving rapidly, are still considerably lower than those common in industrialized countries; this is a consideration which affects the rate at which advanced technologies can be introduced and, more especially, utilized to advantage.

Conventional measures of national income, production, and expenditure suggest very rapid recent growth in the economies of the GCC region, and no doubt this has happened. At the same time, it must be recognized that what is reported as "income" reflects mostly the drawing down of a capital asset -- namely, the oil reserves of the region -- and is thus not a measure of sustainable income. It would be highly desirable to develop a set of national accounts for the region in which allowance is made for resource depletion. While such accounts can represent only rough approximations, they should nonetheless be more realistic than conventional ones.

Based on the conventional national accounting measures, it is clear that oil dominates the economies of the region, accounting for about 60 percent of GDP, overall. At the same time, rapid growth has been experienced in other sectors -- notably in manufacturing; electricity, gas and water; construction;

wholesale and retail trade; and transportation and communications. On the expenditure side, a most striking feature is the very large balance of payments surpluses experienced by all the countries except Bahrain, which amounted to about 35 percent of the region's total value of GDP in 1981. A closely related feature is the very large volume of exports and imports (representing some 72 percent and 37 percent of GDP, respectively, in 1981).

The economic relationships within the GCC region and between the region and the rest of the world are given a closer look in Chapter 3. Particular attention is paid to commodity trade, to foreign asset accumulation, and to migration. With respect to trade flows, it is again noted that the value of external trade has grown very rapidly. There is relatively little trade within the region, compared to the volume with other countries. The trade is mostly with the industrialized nations, which are the destination for about 70 percent of the exports and the origin for a somewhat larger fraction of the imports. While oil accounts for almost all exports, imports are more diversified. Even so, the categories "machinery and transport equipment," "manufactured goods," and "miscellaneous manufactured articles" collectively accounted for about 80 percent of all imports in 1979. Foreign assets were accumulated rapidly in the 1970's, in consequence of the surplus on trade account. The extent of their accumulation is difficult to document, but they appear to have reached at least $100 billion by 1980. As noted above, a concomitant of the rapid economic growth has been the influx of foreign workers. By the mid-1970's it is estimated that they accounted for about half the total labour force in the region, and it seems likely that the proportion is higher now. About two-thirds of the foreign workers were Arabs and about one quarter Asian, although the proportions varied considerably from one country to another.

Part II of the study is concerned with the resource base of the

GCC region, and its utilization. It provides an inventory of the water, agricultural, fisheries, oil and gas, and mineral resources of the region, and also gives consideration to the possibilities for recovering useable resources from available waste materials. The emphasis throughout is at the macro-level, rather than at the level of a single enterprise or even a single country, although data are presented separately for each country whenever possible. We have attempted to see the big picture, from the perspective of the region as a whole.

Good quality water is undoubtedly a valuable resource in the region, and one that is in scarce supply. It is a particularly important resource, since industrial and agricultural activity depend so heavily on it. Furthermore, as stated in Chapter 4, it is a shared resource since much of the water supply is not easily renewable, but instead is fossil water contained in aquifers, many of which are shared by two or more countries in the region. Water resulting from precipitation is very limited in most parts of the Gulf, and often results from high intensity storm-type rainfall. In addition, much water is produced by desalination. Some desalination plants use brackish water from aquifers, in which case a shared water resource may be involved, while others use sea water. Detailed water balances prepared for each country for 1980, with projections for 1985, suggest that while water supplies generally exceed demand in both years, there are problems in particular areas, such as Bahrain. The projected expansion of the water supply in all countries is mainly through the use of desalination plants. Clearly desalination plants are expensive to construct and to operate, which suggests an important role for effective water management policies, as discussed below.

Agriculture is the topic of Chapter 5. It is noted that even with the extreme scarcity in the GCC region of land which is suitable for crops or for pasture, both crop and livestock production increased markedly in recent years, and there is considerable potential for the further expansion of agricultural output. However, the high opportunity cost of water in most of the region suggests that it should be used sparingly: it would seem unreasonable to produce crops or livestock which are valued below the cost of their water input. Also, the introduction of advanced technology in agricultural production requires the use of skilled labour, without which the existing resource base could easily be destroyed. Even with these provisos, there is considerable potential for expansion from existing levels of output. At the same time the output potential is not sufficiently great to provide much of a food security buffer.

The fishery resources of the GCC region also have considerable productive potential. The waters surrounding the region are rich in many varieties of fish, as discussed in detail in Chapter 6, and a very conservative estimate suggests that the overall catch could be increased at least four times before potential yields are fully realized.

Oil and gas, which are the topic of Chapter 7, are obviously the dominant natural resources of the region at this time. As is well known, the region is the world's largest oil producer, and has its largest pool of proven resources. It is less well known that the region also has very large reserves of gas. The strategy for the use of this dominant component of the natural resource base is, of course, a central issue in the region's development strategy.

In Chapter 8 the metallic mineral resource base of the region and its utilization are discussed. The available evidence suggests that the region has substantial deposits of various metallic minerals -- including copper, zinc, lead, iron, chromium, zirconium, thorium, uranium, aluminum, gold, and silver -- and that the deposits are concentrated mainly in Saudi Arabia and Oman. While the known deposits are relatively small when considered on a global scale, they are very important on a more local scale. Furthermore, there is now substantial capacity within the region to produce iron, steel, aluminum, and copper, and some expansion is planned. These industries form a critical link in the on-going process of industrialization, since they provide both relevant materials and critical experience in the use and management of advanced industrial processes.

The non-metallic mineral resources of the GCC region are more widely distributed among the member countries, as noted in Chapter 9. There are large reserves of gypsum, limestone, and clay which supply the cement industry, and of sand and gravel which supply the construction industry. Other reserves -- including quartz sand, ornamental stone, phosphate, sulfur and high salinity sea water -- could also be further exploited.

In Chapter 10, which concludes Part II, it is observed that waste materials can sometimes be used to recover useable resources. Scrap metal recovery and paper recycling are promising possibilities.

Part III is concerned with an overview of possibilities for putting the resource base of the GCC region to effective use over the next few years. The approach adopted in Chapter 11 is to consider an exhaustive classification of commodities, and to provide a necessarily preliminary assessment of the ones whose production might suitably be encouraged in the region, given its resource base. Those commodities whose production requires relatively large inputs of energy and capital, and relatively little water and labour, are candidates for further consideration. Those commodities whose production would utilize the natural resources of the region and also encourage the further development of local human skills are, of course, especially interesting candidates. Throughout this chapter the importance of the market test is emphasized: it is important that the industries which are established by making use of the current oil wealth should not continue to require subsidies, but should instead soon become self supporting and fully competitive, and themselves contribute to the process of further industrializing the region.

13-3. SUGGESTIONS FOR FURTHER CONSIDERATION

In the course of preparing the inventory of the resource base of the region as a whole, a number of comments were made concerning the nature of these resources, and certain suggestions were made regarding their management and development. Such comments and suggestions were included in preceding chapters, and others which we make here are also based on the material in those chapters. We hasten to remind the reader that our suggestions are necessarily general in nature, and are made with a view to focusing discussion in helpful ways, rather than providing specific proposals. Specific proposals would result from feasibility studies which the GCC might itself wish to undertake, or to encourage others to do. The suggestions and comments which follow are presented roughly in the order in which they were made throughout the study. Additional suggestions and comments are included in individual chapters.

1. The effective operation of the GCC in economic and other matters depends critically on the availability of a reliable and unified data base, both for member countries individually and for the region as a whole. The establishment of such a data base might build on cooperation among the existing statistical agencies, and the integration and coordination of their work. Plans might be laid for the regular dissemination of data relating to the region as a whole, perhaps under the auspices of the GCC itself.

2. With respect to the data base, there is a critical need to set priorities so that scarce resources will be used effectively. It is important, for example, that on-going efforts be encouraged so that data relating to national income and expenditures, to the population and labour force, and to the industrial structure of the region, as well as to other matters, be accurate and timely. At the same time there is some urgency associated with the need to review the conceptual basis of what is done; one example of particular note relates to the measurement of income, as discussed above. While it would be possible for some work to be done by outsiders, such work must be communicated effectively to those at the home base if it is to be put to good use.

3. Given the critical importance of the steady flow of skilled and unskilled workers to the GCC region to ensure the success of its program of rapid economic development, thought might be given to the establishment of a regional manpower council. Such a council might work closely with national development planners to find ways to bring balance to regional labour markets without creating undue dependence on foreign labour. It might also be concerned with such matters as the unification of labour codes and safety standards, and with monitoring labour markets and related trends. Again the critical dependence of such an activity on a reliable and timely data base is evident.

4. Water in the GCC region is primarily a shared resource, based on the aquifers underlying the peninsula. The use of this resource is thus a matter of mutual concern. Consideration might therefore be given to the possibility of empowering the GCC Water Committee to concern itself with the utilization and development of water resources at the regional

level. The Committee might also explore possibilities relating to:

(a) the further development of known natural water resources;

(b) the search for new water resources;

(c) the utilization of water from high intensity storm-type rainfall to recharge regional aquifers; in the Dhofar region of Oman for example, there are heavy rainfalls during the monsoon season which should perhaps be exploited;

(d) the more effective use of the current water supply; for example, it might examine the feasibility of extending the use of dual water systems, and of treating waste water for use in irrigation and in the recharge of aquifers;

(e) setting the price of water at a level which reflects its scarcity value; such a policy would discourage wasteful uses of this most valuable and scarce resource.

5. The agricultural sector of the region can contribute to the goals of greater security of food supply and a more diversified economic base for the region, as noted above. However, the efficient expansion of the agricultural sector requires, among other things:

(a) skilled manpower to operate and maintain agricultural implements;

(b) the adoption of highly sophisticated irrigation practices and livestock management, reflecting the scarcity of water and of arable land in the region;

(c) the integration of various activities within the agricultural ministries to ensure that consistent objectives are pursued;

(d) the development and maintenance of a statistical data base to evaluate both existing programs and others which are proposed;

(e) the coordination of the activities of national ministries of agriculture within the region;

(f) the promotion of research to improve yields of native forages for use as livestock feed and to increase productivity of native livestock herds; research should also be directed towards adapting foreign crops and livestock to the high heat and salinity conditions that prevail in the area;

(g) the provision of extension services to inform farmers of new technologies, and to inform agricultural researchers of the problems faced by farmers;

(h) the proper pricing of agricultural inputs, including water, and the stabilization of markets for farm outputs;

(i) a policy of food security which might involve the domestic production of suitable crops and the raising of suitable livestock; many storable food items are best acquired through world trade by setting in place a procurement policy that takes advantage of favourable world market situations and maintains a diversified and a large food storage capacity;

(j) measures to make better use of existing food supplies; a notable possibility is the use of animals sacrified during Haj.

6. The waters surrounding the GCC region are rich in fish resources. A specialized agency might be empowered to manage the shared fish resources in the Gulf, the Arabian Sea, and the Gulf of Oman. Proper management would involve the development of an environmental policy to ensure a steady replacement of the fish population and the assurance of a clean water environment. A specialized agency might:

(a) make it possible to take greater advantage of the considerable economies of scale in fish processing and the fishmeal and canning industries by stabilizing the fish catch through the coordinated expansion of regional commercial fishing;

(b) promote the local consumption of non-traditional fish;

(c) encourage the processing of by-catch into animal feed, particularly poultry feed;

(d) encourage the development of artisanal fisheries in the broad context of promoting regional rural development; a credit-loan scheme designed specifically for artisanal fishermen might help to stabilize their incomes, enhance their quality of life, and maintain them in this traditional activity; fisheries development centres could be created in rural fishing communities to provide fish-landing sites, storage and marketing facilities, manpower training services, boat repairs, and so on;

(e) encourage the Arab Fish Company to expand, promote, and encourage further ventures with experienced Third World fishing countries;

(f) expand local fishing fleets and adapt new trawlers to suit the local environment.

7. The GCC region is the world's largest oil producer and has the world's largest pool of proven crude reserves. It also has very large reserves of natural gas. Moving "downstream" to integrate the various phases and sequences of production -- refining, processing, shipping, marketing -- is an obvious and very promising way in which to encourage industrialization. Up-grading the domestic value-added component of oil and gas based products would provide a productive use for the large financial surpluses of the region, diversify the markets for their products, and vertically integrate their production sequences.

In developments based on the oil and gas sector, the following points seem especially important:

(a) care must be exercised in the early stages to concentrate production on mature products for which the highest fraction of production cost is the value of raw materials and the vulnerability to technological obsolescence is least;

(b) sufficient funds should continue to be committed to build more large regional petrochemical complexes to substantiate the credible threat strategy of persuading competitors of the seriousness of GCC producers' intention to penetrate world markets in these products, and of the need to take this into account in their own planning;

(c) the choice of joint ventures with TNCs should be complemented, perhaps on a larger and broader scale, with joint processing complexes in the Third World;

(d) while the range of petrochemical products should probably be narrow for the short term, this need not be the case for the long term; in the foreseeable future olefins should be interfaced with the production of aromatics to broaden the production base and to move up the production chain from basic to intermediate and final petrochemical products;

(e) since size is a critical variable in the petrochemical industry, cooperative production and investment strategies are necessary; the credibility of the GCC petrochemical complexes increases not only with the amount of capital committed but also with the perceived extent of cooperation and collective action by the countries of the region;

(f) it is also important to coordinate trade policy with planned investments in the petrochemical industry; it is difficult to see Western markets closed to Arab Gulf petrochemical products while Gulf markets remain open to Western products.

8. The GCC region is not rich in known mineral deposits, but a number of deposits have been identified which warrant commercial exploitation (including iron ore, bauxite, copper, and gold). The region is particularly well suited for metal refining and smelting, inasmuch as these activities involve heavy commitments of capital and high levels of energy use, and also because the region is well located between the sources of ores and the markets for final products. The following ideas warrant careful consideration:

(a) the GCC in coordination with the various national ministries of minerals should complete a comprehensive mineral survey of the region; Saudi Arabia already has such a survey, and the UAE has surveyed some of its territory; such surveys need to be completed for the entire region, and their results channelled to a regional registry;

(b) there is a need to consider the backward and forward linkages involved in the processing of minerals for example, ALBA in Bahrain and DOBAL in Dubai could obtain some of their bauxite from deposits in Saudi Arabia, and Saudi ores could be beneficiated with imported ores and used to produce iron in the region using the direct reduction method;

(c) the GCC governments might find it advantageous to invest in mines in Third World countries, particularly those nearby, to assure a committed supply of raw materials to their refineries and smelters.

9. Nonmetallic minerals are widely distributed throughout the GCC region, and some reserves are quite large. For example, the large reserves of gypsum, limestone, and clay could satisfy most of the raw material requirements of the regional cement industry, which has a present operating capacity in the order of 7.3 million tons per year; the extensive reserves of sand and gravel could support regional construction activity; high quality quartz sand available in Saudi Arabia could support a glass manufacturing industry; large reserves of ornamental stone, including marble and granite, could substitute to a greater extent for imported materials; and so on.

   The calcareous phosphate deposits in Saudia Arabia might form the basis for regional phosphate, phosphoric acid, and fertilizer industries. The required sulfuric acid, in turn, could be produced from the sulfur which is a by-product associated with oil and natural gas production. Furthermore, the high salinity sea water, and the extensive rock salt deposits in the region, could be used to support an inorganic chemicals complex to produce caustic soda (useful in alumina refining), magnesia, and magnesium.

10. Enormous volumes of waste materials are associated with modern societies. Often included in such waste are usable materials which could be recovered on a cost-effective basis. Some potentially recoverable materials worthy of study include scrap metal and paper recycling.

11. Extensive use was made of the United Nations Standard International Trade Classification system to classify each traded commodity in the GCC region

in terms of its nature, the complexity of further processing, the potential factor intensity of further processing, and the size of the regional market. A long list of commodities was identified as potentially viable for production and/or expansion within the region. Some of the commodities or activities noted include: poultry production, vegetable and fruit canning, expansion of fisheries, use of by-catch as animal feed, sulfur, caustic soda, gravel, gypsum, inorganic chemical complexes, glass, quartz glass, alumina, aluminum, copper, iron, steel, gold, silver, lubricants, wax, fertilizers, plastics, and synthetic rubber.

12. The GCC region might be viewed as a primary ring of production, and its economic interactions over wider rings, including many Third World countries, could be considered to find ways to exploit mutually advantageous trade and investment opportunities. The Arab ring is a natural extension of the boundaries of production of the GCC region. For example, Sudan could complement the region's food supply, Mauritania could provide the high grade iron ore required by the direct reduction technology to produce iron, Lebanon could provide the entrepreneurial and design skills for the manufacture and marketing of performance petrochemical products, and Egypt, Algeria, Iraq, and Syria could provide manufacturing experience. The Arab ring itself is a potentially large market for the end products of the Gulf refineries and petrochemical complexes, and a steady source of skilled and unskilled labour. There is also scope for a thorough and futuristic stock-taking of the potential of the near-by rings in Africa and Asia as sources of raw materials, location sites of complementary industries, and destinations of trade and capital flows.

13. The multiplicity of different local currencies complicates trade and investment within the GCC region. A single currency area might foster

the expected increase in intra-regional trade and investment. A GCC Payments Union might be considered as a means to strengthen the institutional mechanisms accommodating regional economic interactions.

14. With the exception of Saudi Arabia in the case of a limited number of industries, individual GCC countries will not be able to develop viable engineering products industries because each member country, when operating alone, lacks one or more factors necessary for such development. But together these countries have the potential for the development of viable and dynamic engineering industries. Collectively, the countries might set up a GCC analogue of SABIC to assess, coordinate, and promote the establishment of various industries. On the basis of our preliminary study, it appears that industries to produce telecommunications equipment, power generators, turbines, transformers, switchgears, and capacitors would be promising candidates. This same organization could also initiate pre-feasibility studies with the view to the eventual production of machinery and equipment for the chemical and petrochemical industries contemplated in the region. Included in this group are process vessels, storage tanks, bins, heat exchangers, furnaces and kilns, filters, pumps, compressors, and boilers.

15. The approach to growth and industrialization which is suggested for the region would centre around carefully selected growth poles. However, given the labour, water, and institutional constraints of the region, the growth poles that are emphasized need to be balanced and developments relating to them need to be harmonized and sequenced. We suggest an immediate focus on the production of capital goods. This is because the existence of a capital goods sector promotes all other sectors while itself being least dependent on the development of other sectors.

The GCC is in an ideal position to encourage its member countries to undertake massive and coordinated programs to restructure the region's economy. An efficient and adequate infra-structure is now set in place, there is no need to forego consumption in order to expand investment, there are no shortages of foreign exchange, and the constraint implied by the limited economic size of individual countries is being overcome through regional cooperation. The fact that water, labour, and industrial experience are all in short supply will present serious challenges to the collective will of the region in its attempt to replace oil with sustainable sources of income. However, with dedicated cooperation, foresight, careful planning, and time, the constraints which now limit growth can be relaxed; the opportunities for progress are real and can be realized.

APPENDIX A

Transportation

I. Introduction

The transportation infrastructure of the Gulf Cooperation Council countries has grown so rapidly that statistics on activity levels and facilities are quickly out of date. However, even without the most recent data, the state and prospects for the sector can be understood by analysis of existing facilities and recent growth trends.

A transport infrastructure has developed which now promises to provide an excellent base for future development of both transportation and related sectors of the economy. This is especially to be remarked since rapid economic growth is often accompanied by wasteful investment practices, including inefficient choice of projects and mis-emphasis of transport modes. The present excellent network greatly enhances the outlook for continued development of individual member countries, the promotion of successful economic relations among them, and the needs of mutual defence in the region. Accordingly, the main goals of transport policy for the future should be to ensure that correct decisions continue to be made regarding further investment in transport projects and also that correct signals in the form of prices be given to the other sectors of the economy to enable them to make decisions which are most efficient from the overall point of view of each economy and of the Council. The need for rational decision-making throughout the whole economy becomes ever more urgent as the ultimate exhaustion of oil reserves approaches, as is the case for three member countries whose current known reserves are estimated to expire by the year 2000. It is to the great credit of the member countries that they have been attempting to prepare for this day by careful consideration of the course that their oil-less economies should follow and diversifying investment in preparation for that day.

The principal tool to promote economically efficient decisions within each economy and among them is a properly functioning price system. Transport economists will have to place ever greater emphasis on the implementation of correct pricing principles, which will be a more challenging task as the structure of transport demand becomes more complex. This in turn will require careful analysis of transport costs, which becomes increasingly complex as demand patterns evolve because of the joint nature of much of the transport expenditure which must be allocated to the various users in a rational way.

The price mechanism will be used to give signals to other sectors in their day-to-day operations and in their own investment decisions. If the price system is correctly formulated, we can feel more confident about decisions regarding, for example, the location of new agricultural activities; whether to produce vegetables for export or wheat for domestic consumption; whether it is rational to encourage the development of hydroponic agriculture; where an aluminum smelter should be located; or where a steel fabrication plant should be set up.

The presentation in this chapter is guided by the foregoing concerns. Section 2 summarizes the advantages of different modes in performing various services. Section 3 describes the structure of the transport sector in the member countries. Where possible, obvious "missing links" are indicated or possibilities for the application of new technology, such as slurry pipelines, will be pointed out. In Section 4 we will be concerned with the principles for transport pricing and outline the kinds of data necessary to review present pricing procedures.

2. Characteristics and Advantages of Different Transport Modes

To help evaluate the state of the transport sector and individual modes, it will be helpful to say a few words about the relative advantages and disadvantages of the main technologies: air transport, maritime transport (including coastal shipping), motor vehicle transport, and railroads. Pipelines have, of course, obvious advantages over any alternative for the shipment of liquid in large volumes and need not be discussed further. Slurry pipelines share some of the characteristics of liquid pipelines--no deadhead movements, low one-way costs (although, of course, greater friction prevents attainment of costs as low as costs for liquids)--but drying costs on arrival may eliminate their cost edge over more traditional modes including truck and rail.

In general, air transport for international passenger movement is cheaper than railroads, when railroad costs* cannot be distributed over large volumes; when time is taken into account, air transport has an edge over all alternatives, and is increasingly used even for cargo movements. Air is the most flexible mode from the viewpoint of ease of expansion, and it attains the lowest cost between distant points in the absence of intermediate traffic originations. For these reasons it is particularly suited to the still sparsely settled Arabian Peninsula. It is used on international cargo movements for commodities of medium to high value, a group which includes contra-seasonal agricultural exports to Europe.

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*Unless stated otherwise, in this chapter when we speak of "costs" we have in mind total social costs rather than the private costs or prices paid by users.

Maritime transport has the greatest role to play in moderate- to long-distance international movements for low- to moderate-value commodities. The advantage over truck is especially pronounced if there are many national border crossings by land as is the case to southern Europe, especially for originations in Oman or on the Red Sea Coast whence the maritime route is shortest. High-value commodities, for which time is an important factor, are better suited to truck or air, however. There is also a complementary relationship between ocean-going transport and coastal shipping, even when the latter is conducted in low capacity vessels, small steamers, or dhows, since much of the maritime infrastructure serves the needs of both international and coastal shipping, and both modes share a maritime tradition and have some common labour requirements.

Truck transport is best for medium-length and short hauls, especially for shipments which might otherwise require trans-shipment. For example, while unit costs by dhow would be lower than truck unit costs, since almost anything shipped by dhow would require transfer at origin and destination, alternative truck distances must be fairly long before it pays to use such joint transport processes. Long-distance maritime transport, for which there is little substitute, also frequently requires modal change, but recent developments in roll-on/roll-off, or Ro-Ro, shipping have made this a very popular mode, and the G.C.C. countries have been keeping abreast of these developments and providing the necessary facilities.

One caution that should be kept in mind when analyzing truck transport is that in many analyses of cost it is assumed that the private costs--those costs which are actually paid for by the users--do furnish a sufficient basis for comparison. For example, comparisons are frequently made on the basis of experience in countries containing extensive road networks, and the cost information, adjusted possibly for wage differentials and capital scarcity, are transferred for local use. But this procedure should be avoided for two reasons: (a) in advanced economies there is a large automobile population whose demand for highway provision is relatively inelastic and to which disproportionately large portions of those costs which are truly joint costs, such as grading of the basic route, snow removal, or other time-variable costs, can be apportioned, and (b) quite mistakenly, the trucks are not asked to pay for the damage that they impose incrementally on the system; typically, a truck with axle load twice that of a smaller vehicle will do 16 times as much damage (the AASHO "fourth power law") although this relationship has generally not been successfully incorporated into the pricing structure, causing trucks to operate at volumes in excess of socially optimal levels.

Finally, rail transport, as noted, has greatest advantages on routes with volumes heavy enough to justify the initial implantation expenditure, which usually exceeds that of roads because of the more demanding grade and turning radius specifications. Of course, in regions which are relatively flat which do not exert extremely demanding requirements, rail costs are closer to highway costs. Of course, this statement requires for its accuracy some assumption about the truck size with which the rail service is being compared. Each axle on trucks of 20 tons g.v.w. (gross vehicle weight), distributed over three axles (tractor and one trailer), will do 16 times the damage of trucks with 10 tons g.v.w., and one danger in making road vs. rail comparisons is that the comparison may be implicitly made with the smaller vehicle, concluding that truck is cheaper, whereas the heavier vehicles actually wind up performing the service, resulting in a much higher cost than would have been the case by rail. An advantage with rail is that the axle weight can be controlled much more easily than that on trucks. But for a vehicle-importing country, in contrast with a manufacturing country, the government should be better able to impose restrictions on vehicle size, although it is hard to control the degree of overloading by private truckers.

3. Conditions in the Transport Sector and Individual Modes

In this section we will describe the main characteristics of the transport modes presently existing in the G.C.C. member countries. The modes will be discussed in order of their importance in the region's traffic: air transport, highway transport, maritime transport (including coastal shipping), and railroads. As we will see, there are at present no serious bottlenecks, thanks to the heavy investment over the last five years, which has served especially well to expand airport capacity and relieve congestion in ports.

3.1 Air Transport

Table 12.1 shows the main characteristics for the six countries. Airport location is shown in Fig. 12.1. Average daily traffic rarely exceeding 200 operations (landings plus take-offs), clearly suggest that today there is excess runway capacity at the general international airports. Some constraints on individual functions, such as storage, appear to have been resolved or to be in the process of resolution.

In Table 12.1 we have calculated traffic growth rates for all international airports other than those in U.A.E. for which historical statistics

Table 12.1

Air Transport in G.C.C. Countries

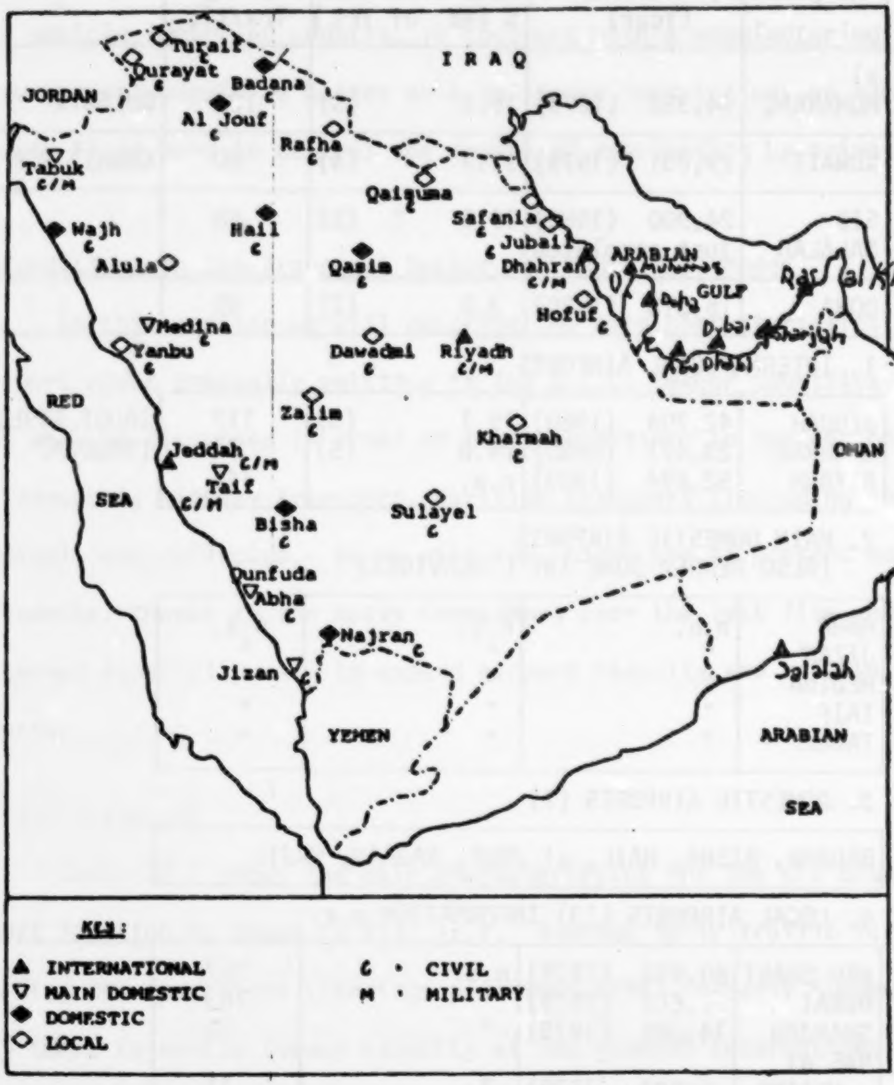
Country	Airport	Total Aircraft Movements (Year)	Recent Annual Rate of Growth % (No. of Yrs.)	Average Daily Traffic	Airline
BAHRAIN	al MUHARRAQ	44,352 (1979)	15.2 (5)	122	GULFAIR
KUWAIT	KUWAIT	29,031 (1979)	11.1 (4)	80	KUWAIT AIR
OMAN	SIB SALALAH	24,900 (1980) just completed	10.6 (5)	68	
QATAR	DOHA	16,518 (1980)	2.0 (2)	45	
SAUDI ARABIA	1. INTERNATIONAL AIRPORTS				
	JIDDAH	42,704 (1980)	15.1 (5)	117	SAUDI AIRLINES (SAUDIA)
	DHAHRAN	23,471 (1980)	24.8 (5)	64	
	RIYADH	52,694 (1980)	n.a.	144	
	2. MAIN DOMESTIC AIRPORTS (ALSO RENDER SOME INT'L SERVICES)				
	ABHA	n.a.	n.s.	n.a.	
	JIZAN	"	"	"	
	MEDINA	"	"	"	
	TAIF	"	"	"	
	TABUK	"	"	"	
	3. DOMESTIC AIRPORTS (7)				
	BADANA, BISNA, HAIL, al JOUF, NAJRAN, WAJIL				
	4. LOCAL AIRPORTS (13) INFORMATION n.a.				
UNITED ARAB EMIRATES*	ABU DHABI	60,917 (1979)	n.a.	167	
	DUBAI	59,687 (1979)	"	163	
	SHARJAH	14,065 (1979)	"	39	
	RAS al KHAIMA	3,993 (1979)	"	11	

*United Arab Emirates traffic includes international and domestic: the breakdown for the four airports is as follows: A D (47,097 intl.; 13,820 dom.). Du (28,882 intl.; 30,805 dom.); Sh (9,481 intl.; 4,584 dom.); R K (2,811 intl.; 1,182 dom.).

Sources: Taken from or calculated from data in annual statistical yearbooks, individual countries.

Figure 12.1

Airports in Gulf Cooperation Council Member Countries, 1982


Turaif C
Qurayat C
Badana C
IRAQ
JORDAN
Al Jouf C
Rafha C
Tabuk C/M
Qaisuma C
Safania C
Jubail C
Wajh C
Hail C
Dhahran C/M
ARABIAN
Muharraq
Alula
Qasim C
GULF
Ras al Khaima
Doha
Hofuf C
Dubai
Sharjah
Medina C
Yanbu C
Dawadmi C
Riyadh C/M
Abu Dhabi
Sib
RED
Zalim C
Kharmah C
Jeddah C/M
Taif C/M
OMAN
SEA
Sulayel C
Bisha C
Qunfuda
Abha C
Najran C
Salalah
Jizan C
YEMEN
ARABIAN
SEA
KEY:
▲ INTERNATIONAL
▽ MAIN DOMESTIC
◆ DOMESTIC
◇ LOCAL
C · CIVIL
M · MILITARY

Source: Transport in Saudi Arabia: Present and Future, Conference on Middle East Transport, Construction and Use, London, March 1976.

were not available. We note that while runway capacity is still ample, the growth figures since 1975 suggest that some pressures on capacity will be encountered by the mid 1980s . Rates of traffic increase of 10-25% are shown for all the airports except Doha in Qatar. Those which are now busiest and have the fastest growing traffic are Bahrain, (ADT 122; RoG 15.2%); Jiddah (ADT 117; RoG 15.1%); Riyadh (ADT 144); Abu Dhabi (ADT 167); and Dubai (ADT 163).

The main activity at the G.C.C. airports has been international passenger travel, and this will undoubtedly continue to be the case. On the other hand, domestic traffic will also grow within the U.A.E., now served by four airports and within Saudi Arabia, with three general international airports, five main domestic airports, and 20 others of national or local domestic orientation.

But it is to be expected that intra-G.C.C. cargo traffic will also rise, as will that to Europe and Southern Asia. This traffic may have certain specialized requirements, (e.g. cold storage facilities), but given the alacrity with which the G.C.C. countries have relieved other needs as they have arisen in their ports, as well as at airports, there is no reason to think that these will present a continuing long term bottleneck.

3.2 Highways and Motor Vehicle Transportation

Tables 12.2 and 12.3 contain the essential information concerning highways and motor vehicles.

Table 12.2 shows the vehicle fleets as recorded for recent years for four of the G.C.C. countries. (Data for Oman and Qatar were not received.) The data are insufficient to enable us to detect overall regional trends. (Information for only one year for U.A.E. was received.) Regarding

Table 12.2

Motor Vehicle Fleets in G.C.C. Countries†

Country	Trucks		Private Cars		Buses		Taxis		Misc.Vehicles	
	000's (Year)	Annual Rate of Growth	000's (Year)	Annual Rate of Growth	000's (Year)	Annual Rate of Growth	000's (Year)	Annual Rate of Growth	000's (Year)	Annual Rate of Growth
BAHRAIN	12.6 (1979)	14.8%	44.9 (1979)	19.2%	2.2 (1979)	16.4%	1.2 (1979)	5.9%		
KUWAIT	135.6 (1980)	15.9%	389.3 (1980)	14.8%	8.4 (1980)	17.2%	9.6 (1980)	4.2%		
OMAN	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
QATAR	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
SAUDI ARABIA*	576.7 (1980)	40.1%	852.2 (1980)	47.1%	30.5 (1980)	39.8%	**	**	24.2 (1980)	41.3%
UNITED ARAB EMIRATES	26.5 (1979)	n.a.	108.4 (1979)	n.a.	2.5 (1979)	n.a.			2.4 (1979)	n.a.

*Saudia Arabian Statistical Yearbook does not publish data on vehicle fleets. Figures used here are cumulative imports assuming ten-year life. i.e., 1980 fleet estimates are cumulative imports since 1971.

**Taxis not reported separately.

†Annual Rate of Growth Based on Five Years experience.

Table 12.3

Main Characteristics of Highway Networks in G.C.C. Countries

Country	Area (000's sq. kilometers)	Population Density (person per sq.kilometers)	Road Density (kilometers of per 1000 sq. kilometers)	Remarks
BAHRAIN	.67			Good internal connections. To be connected to Saudi Arabia by causeway.
KUWAIT	7.8	City 50 Elsewhere < 5		Excellent road network. Connected to Saudi Arabia and Iraq, whence to Europe.
OMAN	300.0	< 3	49	Good and rapidly growing network. In 1980 there were 14703 kms., of which 2173 were paved. RoG, 21.7%, 5 yrs.
QATAR	10.4	15		Excellent network. Connected to Saudi Arabia.
SAUDI ARABIA	2261.1	< 5 (except near Mecca)	5.4	Rapidly developing road network. 1980 had 20238 kms. main roads; 24186 kms. agric. roads. RoG, 5 years: 9.2% main, 23.2% agric. Third FYP includes construction of 12600 kms. Studies to be completed on 57,600 kms. main and 20,000 2nd, 3rd, and earth roads.
UNITED ARAB EMIRATES	76.8	8		Good domestic network, connections to QATAR and OMAN. Road density n.a.

Sources: Qualitative comments based on diplomatic reports, UNECWA report, and Saudi Arabian FYP summary. Quantitative information based on country annual statistical yearbooks.

individual countries, Kuwait does certainly seem to be emerging as a major trucking centre with the second largest recorded fleet and the fastest annual rate of growth--15.9%. Kuwait's bus fleet is also the largest and fastest growing--17.2% annually.

More important than specific components, however, are the generally high rates of growth shown in all countries by most vehicle fleets--15-20% annual growth rates being very common. This ability to grow is reassuring to new entrepreneurs in the region and to the hopes for economic integration.

We turn next to the fixed infrastructure and its growth. Table 12.3 contains the necessary information.

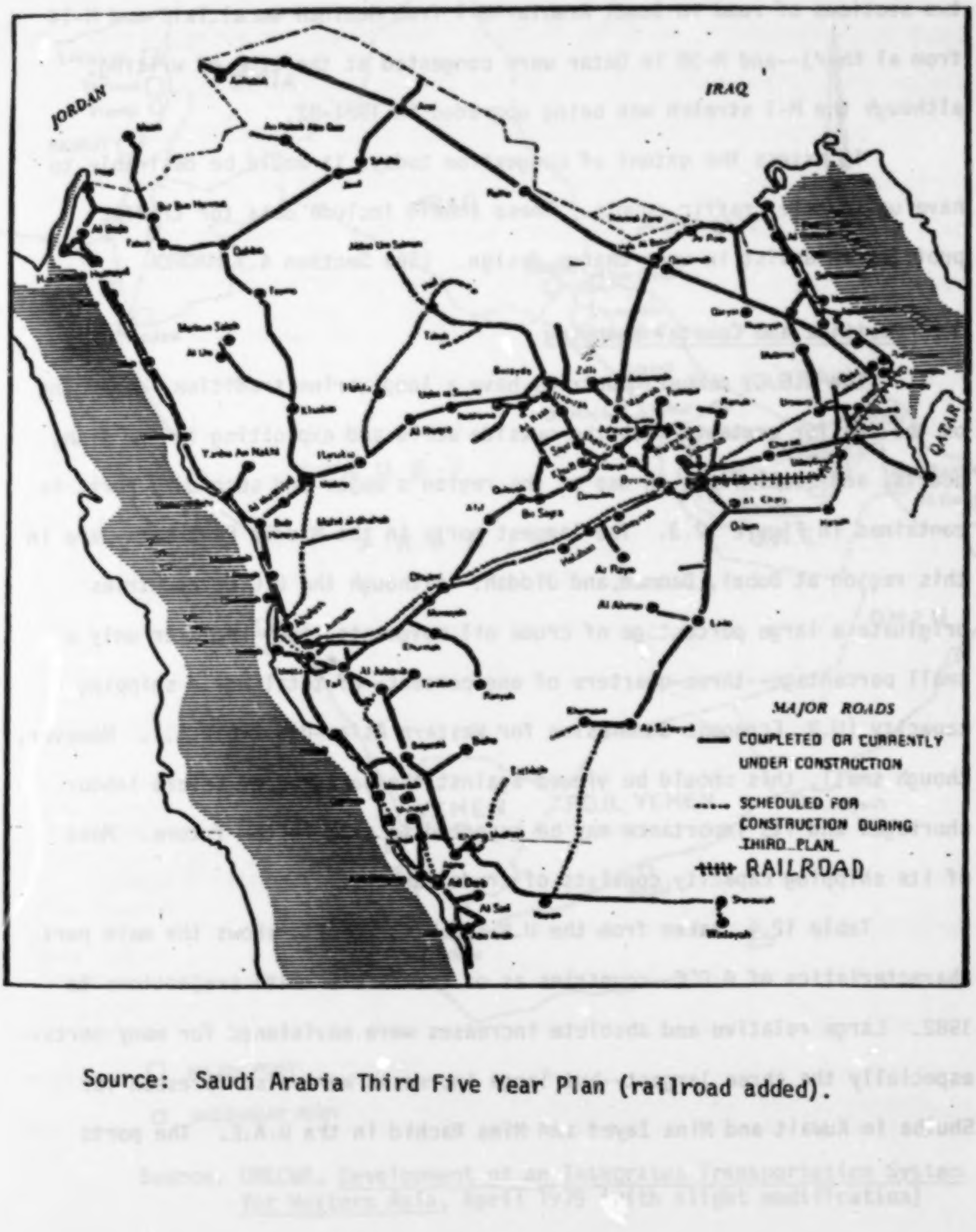
The five countries washed by the Gulf are well-connected, with four-lane highways linking the four countries on the peninsula, and a new causeway joining Bahrain to Saudi Arabia is under construction. Data on total network lengths were not available for all countries.

The low population densities have until recently discouraged rapid expansion of the road networks. This can be conveyed in a rough way by the figures on road density (the road mileage per 1,000 square kilometers) 5.4 in 1980. Oman's is over nine times as high; Qatar, Kuwait, and Bahrain almost certainly are equally high, and the U.A.E., probably somewhere in between. While, as noted, population densities are also very low, especially in Saudi Arabia, the importance of roads for military purposes and trans-peninsula movement, as well as for agricultural development, will continue to stimulate road construction programs.

Figure 12.2 adapted from the Saudi Arabian third Five-Year Plan volume, shows the international road network as of 1980. In that study, it was attempted to estimate current traffic levels and compare them with

Figure 12.2

Major Road and Rail Networks in Gulf Cooperation Council Member Countries, 1980


JORDAN
IRAQ
QATAR
MAJOR ROADS
COMPLETED OR CURRENTLY UNDER CONSTRUCTION
SCHEDULED FOR CONSTRUCTION DURING THIRD PLAN
RAILROAD

Source: Saudi Arabia Third Five Year Plan (railroad added).

estimated road capacities, both as of 1977 and 1978. Assuming annual growth rates of 8 - 10%, the study concluded that the 1980 levels were 20 - 30% higher. They would be proportionally higher today. According to the study, two sections of road in Saudi Arabia--M-1 from Medinah to al Taif and M-14 from al Kharj--and M-38 in Qatar were congested at the time of writing, although the M-1 stretch was being upgraded in 1981-82.

To assess the extent of congestion today, it would be desirable to have up-to-date traffic counts. These should include data for traffic profiles to assist in user charge design. (See Section 4.)

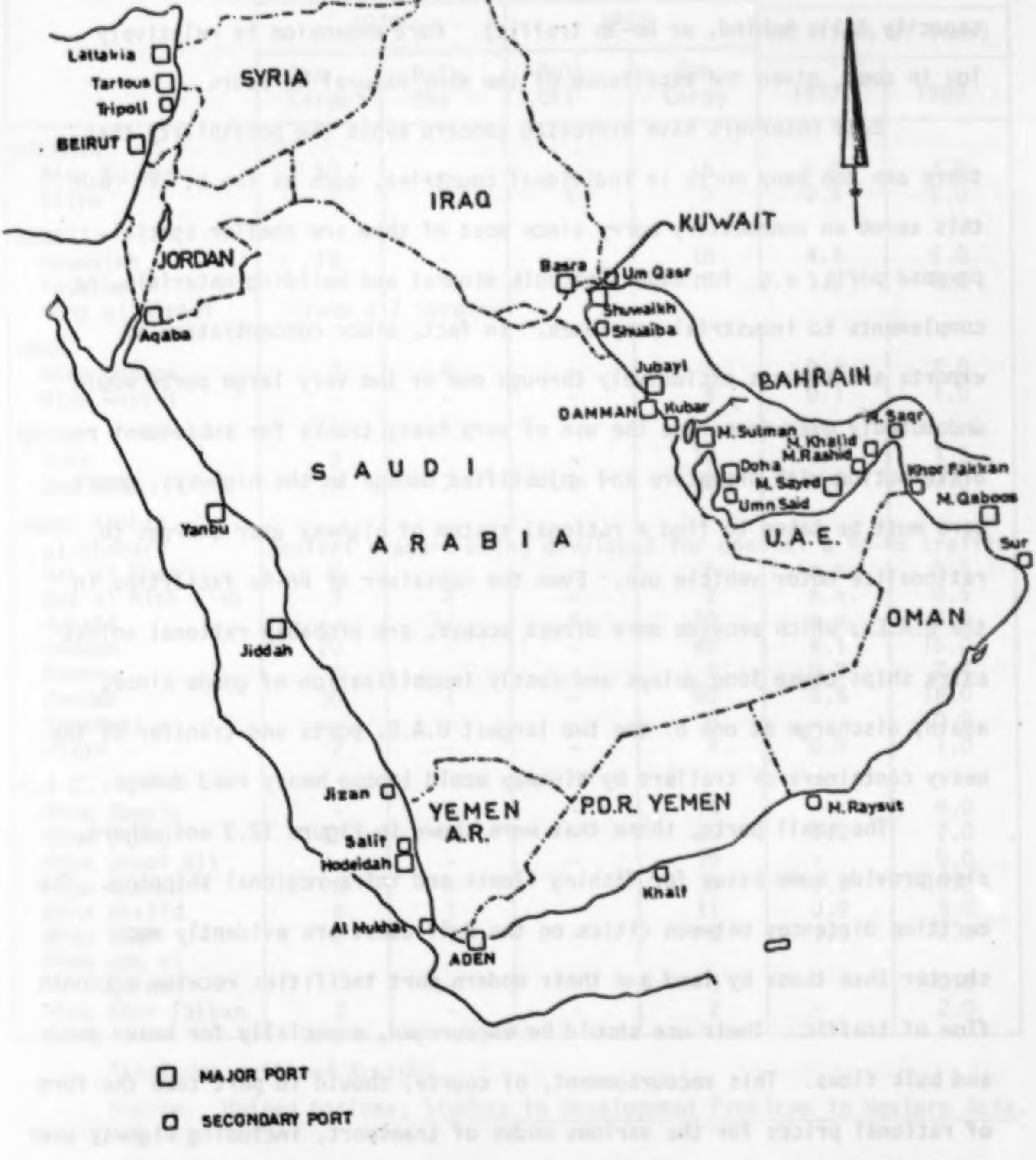
3.3 Maritime and Coastal Shipping

The G.C.C. member countries have a long marine tradition, depending on the sea for contacts with the outside world and exploiting it for fish, pearls, and shell-fish. A map of the region's major and secondary ports is contained in Figure 12.3. The largest ports in the Middle East today are in this region at Dubai, Dammam,and Jiddah. Although the G.C.C. countries originate a large percentage of crude oil movements, they register only a small percentage--three-quarters of one percent--of total world shipping capacity (U.N. Economic Commission for Western Asia--U.N.E.C.W.A.). However, though small, this should be viewed against the backdrop of severe labour shortages and its importance may be expected to grow in the future. Most of its shipping capacity consists of crude tankers.

Table 12.4, taken from the U.N.E.C.W.A. report, shows the main port characteristics of G.C.C. countries as of the 1970's, with projections to 1982. Large relative and absolute increases were envisioned for many ports--especially the three largest--but large increases were also foreseen for Shuiba in Kuwait and Mina Zayed and Mina Rachid in the U.A.E. The ports

Figure 12.3

Ports in Western Asia


Lattakia
Tartous
Tripoli
BEIRUT
SYRIA
IRAQ
KUWAIT
JORDAN
Aqaba
Basra
Um Qasr
Shuwaikh
Shuaiba
Jubayl
BAHRAIN
DAMMAN
Kubar
M. Sulman
M. Saqr
M. Khalid
M. Rashid
Doha
M. Sayed
Umn Said
Khor Fakkan
M. Qaboos
Sur
SAUDI
ARABIA
Yanbu
U.A.E.
OMAN
Jiddah
Jizan
YEMEN
A.R.
P.D.R. YEMEN
M. Raysut
Salif
Hodeidah
Khalf
Al Mukha
ADEN
MAJOR PORT
SECONDARY PORT

Source: UNECWA, Development of an Integrated Transportation System for Western Asia, April 1979 (with slight modification) should be able to handle the volumes anticipated, given that investments have been in progress over the last five years, although there may be some bottlenecks in individual types of traffic, (e.g. for containers if crane capacity falls behind, or Ro-Ro traffic). Port expansion is relatively low in cost, given the excellence of the many natural harbours.

Some observers have expressed concern about the possibility that there are too many ports in individual countries, such as the U.A.E. But this seems an unnecessary worry since most of them are smaller special-purpose ports, e.g. for export of bulk mineral and building materials, or complements to industrial complexes. In fact, since concentration of exports and imports exclusively through one or two very large ports would undoubtedly over-encourage the use of very heavy trucks for subsequent re-distribution with premature and unjustified damage to the highways, great care must be taken to find a rational system of highway user charges to rationalize motor vehicle use. Even the container or Ro-Ro facilities in the U.A.E., which provide more direct access, are probably rational unless extra ships cause long delays and costly immobilization of goods since, again, discharge at one of the two largest U.A.E. ports and transfer of the heavy containers or trailers by highway would impose heavy road damage.

The small ports, those that were shown in Figure 12.3 and others, also provide home bases for fishing fleets and intra-regional shipping. The maritime distances between cities on the Gulf coast are evidently much shorter than those by land and their modern port facilities receive a smooth flow of traffic. Their use should be encouraged, especially for heavy goods and bulk flows. This encouragement, of course, should in part take the form of rational prices for the various modes of transport, including highway use

Table 12.4

Characteristics of Ports in G.C.C. Countries

	Number of Berths				Dry Cargo Capacity (Millions of Tons)	
	1978		1983			
	Gen Cargo*	Bulk Dry	Bulk Oil	Gen. Cargo	1977	1983
BAHRAIN						
Mina Sulman	10	-	-	16	0.9	3.0
Sitra	2	3	6	2	0.5	2.0
KUWAIT						
Shuwaikh	18	-	-	18	4.4	6.0
Shuaiba	9	4	4	15	1.0	5.0
Mina al Almadi	Crude oil terminal					
OMAN						
Mina Qaboos	7	4	-	8	0.8	2.0
Mina Raysut	-	-	-	4	0.1	1.0
QATAR						
Doha	9	-	-	13	0.7	1.5
Umm Said	10	7	2	2	1.0	17.0
SAUDI ARABIA						
al Khobar	Ancient seaport being developed for coastal & Ro-Ro traffic					
Ras al Ghan	6	-	-	6	n.a.	0.5
Ras al Mish a'ab	2	2	-	2	n.a.	0.5
Jubail	-	11	4	10	n.a.	5.0
Dammam	20	-	-	40	8.1	16.0
Yanbou	2	-	-	9	0.9	2.4
Jeddah	30	1	-	45	9.5	18.0
Turwiwal	-	-	-	4	-	0.5
Jizan	2	-	-	4	0.6	1.0
U.A.E.						
Mina Ruwais	-	-	-	14	-	4.0
Mina Zayed	12	1	-	25	1.5	7.0
Mina Jebel Ali	-	-	-	19	-	5.0
Mina Rashid	16	3	-	35	3.8	10.0
Mina Khalid	6	1	-	11	0.9	3.0
Mina Saqr	6	1	-	9	1.0	2.5
Mina Umm al Qaiwan	-	-	-	1	-	0.3
Mina Khor Fakkan	2	-	-	2	-	2.0

*Includes unitized freight.

Source: United Nations, Studies in Development Problems in Western Asia.

charges. (See Section 4.) Even shipments around the peninsula to Oman and the Saudi Arabian Red Sea Coast can often be more advantageously made by coastal shipping; the ton-mile total social cost (i.e. the cost inclusive of the road damage that the truck may not be paying for) by road is so much greater than the ton-mile social cost by water that the total shipping cost will often be much lower by sea even though the maritime distances may be 200% or more greater than the land routes.

3.4 Railroads

Railroads have not been an important transport mode in this region. Historically, railroads have played their greatest role in countries and regions with heavy bulk freight traffic flows which generate high total revenues at low unit prices, supplemented by smaller volumes of high value freight or passenger traffic paying higher unit prices, all of them together covering total cost and allowing a return to the investment.

In the Gulf region the main bulk cargoes have been crude oil and gas which are shipped most cheaply by pipeline. And since their modern development has taken place in the era of cheap air travel, there has been little need for railroads for passenger traffic, and railroad construction, accordingly, has been limited to a single standard gauge line running 582 kilometers from Dammam to Riyadh. But even this line, on the whole, has not been intensively utilized.

The most valuable measures of the appropriateness of traffic for a railroad are average length of cargo haul or average passenger trip length, and density of freight and passenger traffic. The first two are calculated as the total ton-kilometers (passenger-kilometers) divided by total tonnage

Table 12.5

Evolution of Average Trip Length and Density of Use on Dammam-Riyadh Line

Year	Freight Traffic				Passenger Traffic			
	Average Length of Haul		Density (thousands of ton-kilometers per kilometer of track)		Average Trip Length		Density (thousands of passenger-kilometers per kil. of track)	
	Kilometers	1971= 100		1971= 100	Kilometers	1971= 100		1971= 100
1971	41	100.0	67.0	100.0	367	100.0	71.8	100.0
1972	64	156.1	117.5	175.4	363	98.9	83.0	115.6
1973	55	134.1	106.5	159.0	358	97.5	104.6	145.7
1974	60	146.3	110.8	165.4	283	77.1	122.8	171.0
1975	47	114.6	117.3	175.1	345	94.0	117.0	163.0
1976	19	46.3	147.1	219.6	334	91.0	113.6	158.2
1977	33	80.5	214.3	319.8	322	87.7	162.0	225.6
1978	144	351.2	255.5	318.3	224	61.0	108.9	151.7
1979	199	485.5	360.8	538.5	269	73.3	127.5	177.6
1980	295	719.5	448.4	669.2	323	88.0	140.9	196.2

Source: Calculated from Table 8-19, p. 358, Statistical Yearbook.

Ministry of Finance and National Economy, Kingdom of Saudi Arabia.

(passengers) moved, while density is the quotient of total ton-kilometers (passenger-kilometers) divided by length of line. In Table 12.5 we have calculated these measures on the Dammam - Riyadh line from the 1980 annual Statistical Yearbook.

Evidently, passenger traffic has been relatively stable since 1970: the average length of haul, around 325 kilometers through the period, represents a good run; but the density of around 125,000 passenger-kilometers per kilometer of track is light.

Freight traffic until 1979 was extremely light and short. Since then, the situation has been changing, with average length of haul increasing 6-8 times, and density tripling or quadrupling over the levels of earlier years. The present average haul--295 kilometers in 1980 and growing rapidly--is a very respectable length, and it will undoubtedly increase further as customs clearance operations are tranferred inland. The density in 1980--450,000 ton-kilometers per kilometer of track--is much lower than densities in railroad-intensive countries which reach 3-10 million t/k. But since the latter include large quantities of bulk cargoes, the comparison should be construed as only suggestive rather than definitive.

A study of this line and railroads in general is being undertaken as part of the present Five-Year-Plan. It will undoubtedly be very informative and helpful.

There is one other line in Saudi Arabia--a historical legacy--the extension of the narrow gauge Hejaz Railway from Damascus. Built before World War I, it was abandoned in 1924. There are no plans at present to restore it.

There are no railways in any of the other G.C.C. countries.

3.5 Slurry Pipelines

Pipeline transmission of slurries, i.e. crushed or particulate matter suspended in a liquid, represents a recently developed technology. While much experimentation remains, there have already been several successful applications: a 170-kilometer coal pipeline in Ohio built in 1957, a 440-kilometer line between Arizona and Nevada, and a 400-kilometer iron ore pipeline in Brazil. Recently, large-diameter (up to 750mm) lines have been proposed for even longer distances, 1600 kilometers and more.

Today in the U.S., two controversial issues restrain more rapid and widespread acceptance: (i) shortages of water in some areas where appropriate bulk commodities are being shipped, especially in the west, and (ii) restrictions imposed by railroad interests seeking to maintain and expand their share of bulk cargoes.

Slurry pipeline transmission posesses the pipeline characteristics of obviating the need for deadhead traffic which sharply reduce unit costs. Given the extensive pipeline experience in the G.C.C. region, slurry lines in some areas should be easy to undertake. Possible candidates for slurry line transmission include chrome and zinc ore in Oman, bauxite to the Jabal Ali aluminum smelter in Dubai, and various products in Saudia Arabia if mineral exploitation is developed. Water scarcity would restrict applications, but in some cases crude oil could be used as the vehicle (e.g. for limestone for portland cement production).

4. Pricing

The Gulf cooperation Council is fortunate in being disposed of a generally first-rate transportation infrastructure. Of equal importance, it is heir to a tradition of generally rational growth, resisting so far the temptation to over-expand, that has characterized many developing countries. In the years ahead it will be necessary to maintain this tradition: half of the member states estimate their oil reserves at 20 years or less. And along with their good judgement in recognizing the need to foster other industries and promote agricultural production to guard against this day, as they have been doing, they must carefully allocate investment to transport modes and to avoid having to support inefficient transport links.

The surest way to ensure efficient location for activities and selection of projects requires a correct pricing structure for transport services. In many countries, pricing aspects are neglected, the assumption implicitly being that the only challenge is to decide what to build and then to do so. The result is what may best be described as stimulation of socially inefficient demands. The fact is that the planners must have some signals to respond to, and it frequently or usually is traffic growth that is used. But the traffic may be inefficiently stimulated through a faulty pricing mechanism.

The surest way to ensure efficient use of transportation is by correct pricing. This relates both to existing transport services by existing producers and consumers and to the location of new production activities which will use transportation. These aspects of the transport planning are neglected in many countries. The result is usually duplication of facilities, e.g. railway and highway, overbuilding of individual modes, or mislocation of activities, with firms locating in a way which uses too much of the transport input in relation to what would be efficient.

Two of the most frequently made errors in transportation pricing arise in the railroad rates and highway user charges. For railroad transportation, the average cost per ton-mile decreases with increasing trip length, of course, since there are loading and other handling costs that must be undertaken for any trip; the longer the distance, the lower the average cost. However, the incremental cost, i.e. the cost to go an additional mile does not decline; it remains the same at 100 kilometers or 500 kilometers as it is at 10 kilometers. But many countries have railroad rate structures in which the incremental rate decreases. This is the case in major western hemisphere countries and other important regions as well. One of the few exceptions, interestingly, is Iraq, where the incremental rate is constant. The overall Iraqi rate structure, in fact, is generally sound, or at least it was in the early 1970's. At that time, rates appeared to reflect very well the costs that were imposed by various commodity classes, the most important exception (grain, whose shipment was heavily subsidized) being justified on income distribution grounds.

The other main potential for miscalculation or mis-pricing is highways. Traditional pricing structures include time charges and materials consumption charges. Examples of the first are registration fees; examples of the second, sales taxes on spare parts and fuel taxes. All of these charges are more or less intended as surrogate methods for charging for the use of the road. But they fail to reflect the most important dimension of road cost, namely the damage imposed on the system by the passage of the vehicle. This damage rises exponentially with axle-weight: generally speaking, the ratio of the damage coefficients of two vehicles is equal to the fourth power of their weight ratio. Thus, if one vehicle has an axle load 50% greater than a second (a ratio of 1.5%), the relative damage imposed is 5, i.e. the heavier truck imposes 400% greater damage, although it is only 50% heavier. But fuel consumption, and, hence, fuel taxes, not to speak of registration fees as usually designed, decrease per ton-mile with rising weight. But taxes per ton-mile in this case should be five times as high!

The importance of correctly pricing highway services may best be understood by reference to a specific example. Suppose it is decided to expand inland cement production on the basis of a new high-quality limestone deposit. Should the plant be established near the deposit and the gas transmitted there by pipeline, with the cement then shipped out by truck? The truck would be very heavy, 35 tons gross vehicle weight or more, and it would impose great damage on the road. Or should the limestone be shipped to the local consumption centre by slurry line? Clearly, if we neglect to take account of truck damage and fail to impose a charge that rises exponentially with vehicle weight, the correct decision will probably not be made by the industry planner or private firms.

As noted, a great deal of information has accumulated concerning the damage weight relationships and also about the costs of collecting by different mechanisms. Essentially, what must be done is determine the total volume on the network and weight each vehicle class by the correct AASHO damage coefficient to determine the equivalent traffic ton-mileage. The total annual maintenance must then be divided by this sum to determine the cost per equivalent traffic unit. Finally, each truck class should be charged according to the equivalent traffic units of the class.

Naturally, in this procedure, the military and defense needs for the roads should be taken out and excluded from the portion on which the user charge calculation is based. But this should not be too hard.

5. Conclusion

The present state of the transport sector in the Gulf Cooperation Council is good and should provide the basis for successful industrialization and diversification. Past experience suggests that as needs arise they will be taken care of in a rational and efficient manner. The issue of pricing will loom ever larger in the future, and it is to this that we urge attention be increasingly focused.